MODERN Plastics

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March In the illuminated advertising display field, plastic materials, molded, cast and laminated, have been used in a variety of interesting, eye-catching applications. The Lauv-Lite sign illustrated at the left, is one of the many types which will be described and pictured in the March number.

Included in our enlarged Technical Section, there will be a discussion of *Thermal Measurements and Control in Molding Plastics*, by J. Delmonte. This report was originally presented as a contribution to the symposium on Temperature, its Measurement and Control in Science and Industry, held by the American Institute of Physics in November 1939.

Precision molded by Richardson for Belmont Radio Corporation, Chicago, Ill.

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Surface beauty is not enough — it must be backed by performance. For that reason every INSUROK precision molded part or product not only possesses pleasing appearance but delivers the utmost in utility and dependability. Manufacturers are quick to appreciate these advantages. More and more Richardson facilities are called upon to assist in adding eye appeal, greater salability, and improved performance to numerous diversified products. Quite likely you're missing something by not availing yourself of this service. Why not investigate?

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MODERN PLASTICS

FEBRUARY 1940 VOLUME 17 NUMBER 6

Inside and out, plywood is used to surface this auto supply station. All-weather exterior, with its rounded corners, is constructed of Resnprest panels in several thicknesses

Speed and Economy with Plywood

by C. R. SIMMONS*

Where wood will do—resin-bonded plywood will do better

SAVING more than $1000 per station, getting the stations built more quickly and being able to salvage much of the construction material when location changes are necessary, has interested a number of oil distributors, especially on the Pacific coast.

These savings are made possible through the use of resin-bonded plywood in place of metal as surfacing material, but that little compound word, *resin-bonded*, means a plywood that can be used for exteriors as well as interiors because it is weatherproof, highly resistant to termite and fungus growth, strong and flexible.

*Durez Plastics and Chemicals, Inc.

Take the case of the Thrifty Auto Supply station (Fig. 1) and read what J. A. Patterson, manager of the Federal Distributing Co. which handles Sunset products, has to say about it: "This is the first unit of a number to be built for this company. Its exterior is constructed completely of a waterproof, all-weather plywood that is widely used in boat building. Eighth-inch, 3-ply panels were used in the rounded corners. These were superimposed upon laths and nailed direct to the studding. The rest of the panels were all of three-eighths inch thickness. The interior finish is regular plywood. The phenolic resin-bonded plywood

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PHOTOS, COURTESY M & M WOODWORKING CO.

Reducing costs for building large service stations, Resnprest plywood panels, 1/2 in. thick, are quickly nailed directly to the framework **2.** This method of attachment allows a 50 percent salvage of material if removal is necessary. Planned for snappy service, the completed station **3** has a smart clean exterior that will endure

was used instead of metal because of a fifty percent saving in cost and because of its workability for rounded corners and cutouts."

Look at the station constructed for Standard Oil Co. at Portland, Oregon (Figs. 2–3). One-half inch thick panels were nailed directly to the framework. C. E. Waterman of that company reported more than $1000 per station was saved by using resin-bonded plywood manufactured by M & M Wood Working Company.

The manufacture of plywood is, of course, not a new industry. In fact, it's more than 3500 years old—goes back to the old Masters of Egypt. Perhaps it's a good thing they could not have foreseen the extent to which this one of their brain children would grow and the economic advantages it has given this generation. We'd probably be paying a Pharaoh's ransom for the happy combination of plastics and plywood. For, while the Egyptians actually founded the plywood industry, it remained in a comparatively lethargic status until our modern chemists gave it a new lease on life. The secret of successful plywood manufacture lies in its glue line. The old-timers recognized this and were constantly striving for new adhesives. Vegetable and animal glues were improved. Casein and sodium silicate were introduced. Then came the blood glues. From the few records available, the glue of the ancients is similar to those of the animal, vegetable and casein glues we know today. But they did have something that really stuck, because perfect specimens of inlaid veneers, which endured through the ages have been unearthed by contemporary archeologists.

The reason for our vital interest really takes us back but fifteen years—not quite half-way to the commercial beginnings of the phenolic plastics industry—because it is the phenolic-resin adhesives that have made the new weatherproof plywood possible. First credit

for the evolution of a phenolic-resin adhesive is generally given to a German research and chemical manufacturing company. It was used, and still is being used in enormous quantities, in the form of a sheet film. This film consists of a thin paper thoroughly impregnated with resin. It is placed between the veneer and core of the plywood and hot-pressed. While this type of adhesive is eminently successful, costs are rather high from the volume production standpoint. Consequently, a great deal of chemical research has been taking place to perfect the liquid-type adhesives which can be fitted into standard plywood production methods. One of the first of the liquid types to appear ten years ago had its drawbacks, too. It had a tendency to soak into the veneer. A dry resin type was developed which was spread over the veneers and cores previously saturated with a solvent. The staining problem created by this method was eliminated, but production costs still remained high. Finally, a colloidal type has been produced which seems to meet objections to the other types. This resin adhesive permits a wider range of control in quantity required for a specific grade of veneer and core. This type is now being used in large scale production of plywood.

If you're familiar with the characteristics of phenolic molding materials, you'll quickly realize why plywood manufacturers have been so whole-heartedly behind the development of the phenolic resin adhesive. A great many of the physical properties of these resins are delivered to the finished piece of plywood. The bond produced is unaffected by heat, water, oil, mild acid and alkalies, and atmospheric changes. Only fire will really destroy it.

These are some of the reasons why phenolic resin-bonded plywood has been adopted by the gasoline service station builder. He has *(Please turn to page 64)*

4

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Tank or tummy service—plywood does the housing job. Signal Oil Co. station, **4** and the Cathay Cafe, **5** both in Portland, Oregon, use Resnprest panels for smooth exterior contours. Side walls are formed of $^{3}/_{8}$ in. panels; rounded corner effects for the cafe were obtained by $^{1}/_{4}$ in. panels with $^{1}/_{8}$ in. thicknesses on top. Forming an unbroken surface, joints, filled with mastic and then painted with three coats of lead and oil, are practically invisible

Always "open for business," U-Need-A-Pak cigaret vending machine, designed by Peter Müller Munk, has double mirrors, slanted toward the outside, eliminating blocking of access to potential customers. Red plastic darts below the mirror, and round knobs of cast resin, draw attention to merchandise and operation of the machine

1

Vending Machine Glamour

by PETER MÜLLER MUNK

Color and light demonstrate their ability to attract attention to these silent salesmen

A tremendous market for plastic materials in keeping with 1940 modernization was demonstrated from January 15 to 18 at the annual convention and exhibit of Coin Machine Industries, Inc., at the Sherman Hotel in Chicago. Therefore, these remarks by Peter Müller Munk, Product Designer, Carnegie Institute of Technology, are timely and pertinent to the part plastic materials are playing in the growth and expansion of this already extensive market. (*Editor's Note*)

IN THE ingenious and sometimes spectacular applications of plastics to more and more diversified groups of products and uses, each invasion into a new industry constitutes a chapter of singular importance. Frequently, in fact, an entire industry may gravitate in their direction and the plastics find themselves established in a new field almost overnight. That such annexations of new territory sometimes occur in rather exposed and unexpected fields only makes the advance more colorful and interesting. While my first commission for a vending machine was somewhat of a surprise to me, I have since learned how futile it is ever to be startled by the vitality and progressiveness of this industry. The very pace and daring that motivates the manufacture of vending machines has in itself a good deal in common with the inventiveness of the plastic producers. Here then is a case in which, by temperament and actual need, the plastics and the product quickly combine for the greater glory

of both. For the designer in particular, the vending machine industry offers a most stimulating and demanding opportunity. Even the most cursory inquiry reveals certain very definite manufacturing and form requirements which point toward plastics as the most natural and convenient solution. In the first flush of their young love for each other a good many gaudy and unintelligible exaggerations have been committed by the vending machine manufacturer, as well as the plastics salesman, but the permanent position of the plastics in this field seems assured.

To the casual reader any mention of vending machines will probably conjure up a rather vague picture of pin ball games and a dim recollection of the unsavory word, *slot machine*. A more realistic and mature inquiry into the scope and nature of the industry will, however, quickly dispel any such misapprehensions. The background and the growth of some now well-established leaders in the coin machine field do indeed reveal a measure of recklessness and at times an almost naive faith in the gullibility of their fellow citizens. Since those days, however, much has happened to change and to stabilize the industry until today it represents a capital investment of almost fifty million dollars and the range of its products has not ceased to grow. In my association with this group I have found a most refreshing youthfulness and eagerness for new thought and new materials which has been most helpful to my aims as a designer and, incidentally, to those of the plastics industry.

At the moment, the vending machine industry is, almost going through a plastic phase and I am somewhat afraid that the occasional over use of plastics will soon have a reaction. On the other hand, the pacesetters of the industry realize their debt to the appeal and beauty of plastics and they will not easily abandon them. The fact that James Mangan, of the Mills Novelty Co., has chosen a phenolic for one of that company's most recent and most ambitious ventures into the music field augurs well for the continuance of plastics in the entire industry. What then are the requirements of the vending machine manufacturer and what role do the plastics play in the achievement of his goal?

If we consider a vending machine as any coin operated mechanism we will, perhaps, most quickly understand the extent to which we have already been captured by them. From chewing gum and cigarets to the latest ditty of Benny Goodman—almost literally from soup to nuts—we are surrounded by an amazing variety of intricate mechanisms which sell all kinds of merchandise and amusement without benefit of any counter or sales person. The latest devices for dependable hygienic and honest mechanical sales represent tremendous investments in engineering skill, as well as manufacturing costs. Competition between the various producing firms and distributors is intense and the profits or losses are frequently staggering. Because of the great differences of usage and location of individual vending machines, it is difficult to determine a general trend by the industry as a whole. However, the application of coin-operated mechanisms is constantly being applied to new fields. Automatic drink mixers and bulk vending machines for nuts and candy, as well as scientifically accurate music machines are merely some outstanding examples of a universally progressive industry.

The tremendous increase in the use of plastics by this industry—so far mainly in connection with cabinets—has perhaps not received enough recognition by those ordinarily interested in the progress of plastics. This, in spite of the fact that here is perhaps one of the most logical fields for the resin manufacturer and one which is continuing to go places. The properties of many of the synthetic resins and the peculiar requirements for a successful vending machine complement each other unusually well.

The principle of the average vending machine rests on its purely mechanical salesmanship. Where other merchandise can depend to a considerable degree on the personality and acumen of the salesgirl or man behind the counter, the coin machine must persuade and ingratiate itself alone. (*Please turn to page 66*)

Both sides and speaker of the Throne of Music, automatic coin-operated phonograph manufactured by Mills Novelty Co., are illuminated from within. Sides, front pilaster and large top caps with compound radii, are cast resin in brilliant color combinations

2

How Do Costs Compare?

by D. A. DEARLE

There are a number of factors to consider in comparing injection molding costs with those of compression molding and this author points out some of the more important considerations

IT WILL be remembered that, when first introduced, the injection method of molding plastics was not received with very great enthusiasm by the majority of those engaged in the industry. During the past few years, however, this attitude has changed considerably. The chief reason for initial skepticism was undoubtedly due to a fear that the injection process would tend to make compression machines obsolete and a certain amount of this indifference can be attributed to such thoughts. On the other hand there were many who recognized definite limitations to the innovation and felt it was just a transient phase of the industry.

Since the first injection machine appeared in this country, however, great strides have been made not only in improving the methods of operation, but also in the type and size of the press itself. While the capacities of even the largest of such machines still cannot compare with those of the prodigious compression presses, the platen sizes are constantly increasing and the limit has, as yet, by no means been reached. Consequently, injection molding has finally gained a very definite place in the plastics industry and from all appearances seems to be well ensconced in its present position.

To many of those who have invested thousands of dollars in compression equipment the question naturally arises as to just what the future holds for their molding facilities. A certain amount of justifiable concern is felt regarding the ultimate utility of a plant filled to capacity with compression presses, and the entrepreneur, likewise, becomes chary about the type of equipment he should purchase for his needs. Actually there should be no cause for worry on the part of any of those actively engaged in the industry, for although injection molding is here to stay, it seems highly improbable that it will either revolutionize the industry or cause existing equipment to become obsolete. Those who harbor thoughts of having to jettison their presses have only to remember that injection machines are augmenting rather than supplanting compression presses in the majority of cases.

TABLE 1. COMPARATIVE COST BASED ON VARYING MOLD CAPACITIES AND WEIGHTS

		Compression Molding				Injection Molding			
No. of Cavities	Material Weight (lbs. per thousand pieces)	Material Cost	Molding Labor	Molding O'Head	Mfg. Cost	Mfg. Cost	Molding O'Head	Molding Labor	Material Cost
1	2	.72	20.00	30.00	50.72	9.36	5.01	3.34	1.01
	10	3.60			53.60	13.39			5.04
	20	7.20			57.20	18.43			10.08
	50	18.00			68.00	33.55			25.20
4	2	.72	5.00	7.50	13.22	3.05	1.26	.84	1.01
	10	3.60			16.10	7.14			5.04
	20	7.20			19.70	12.18			10.08
	50	18.00			30.50	27.30			25.20
16	2	.72	1.25	1.88	3.85	1.54	.32	.21	1.01
	10	3.60			6.73	5.57			5.04
	20	7.20			10.33	10.61			10.08
	50	18.00			21.13	25.73			25.20
30	2	.72	.67	1.00	2.39	1.29	.17	.11	1.01
	10	3.60			5.27	5.32			5.04
	20	7.20			8.87	10.36			10.08
	50	18.00			19.67	25.48			25.20

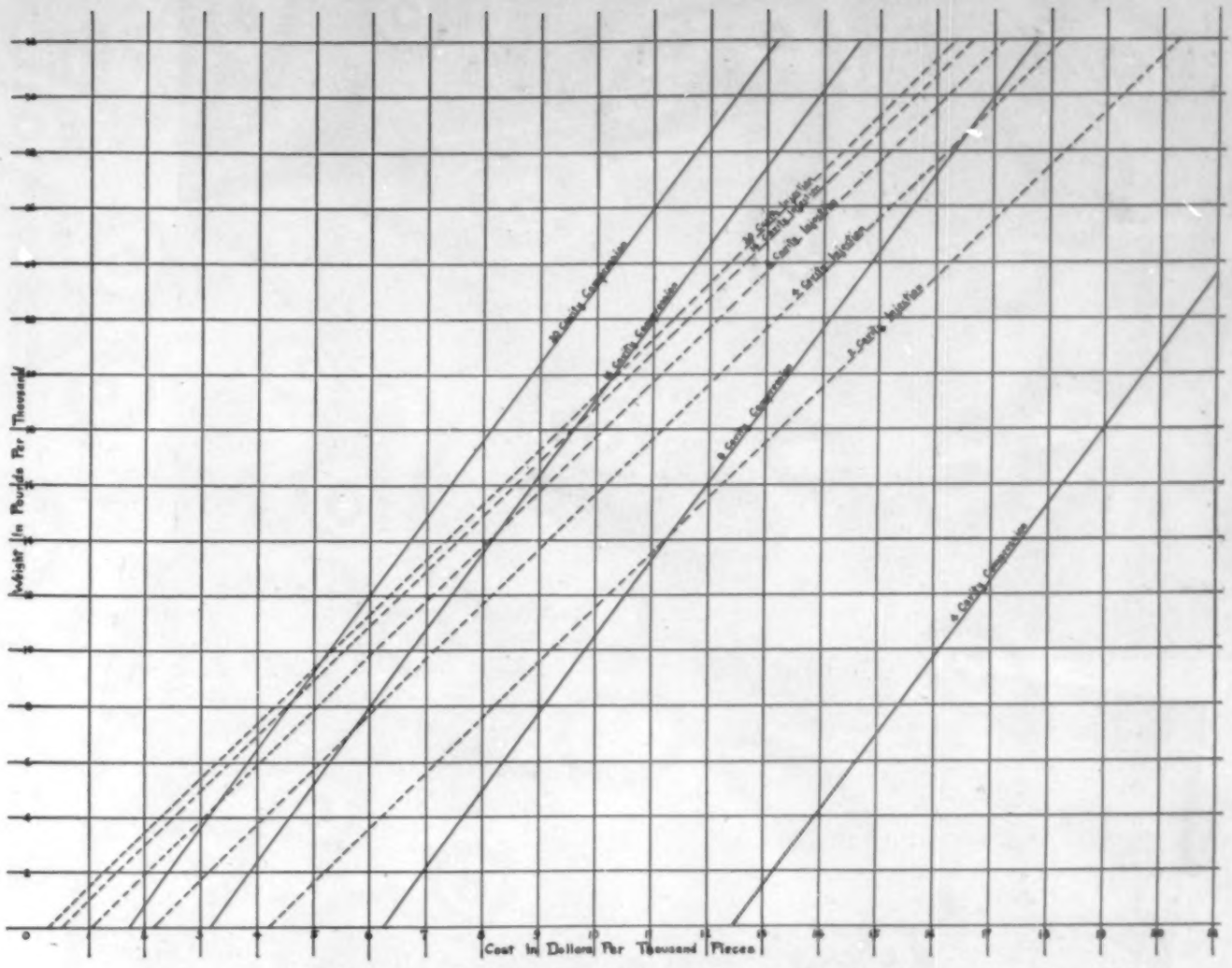


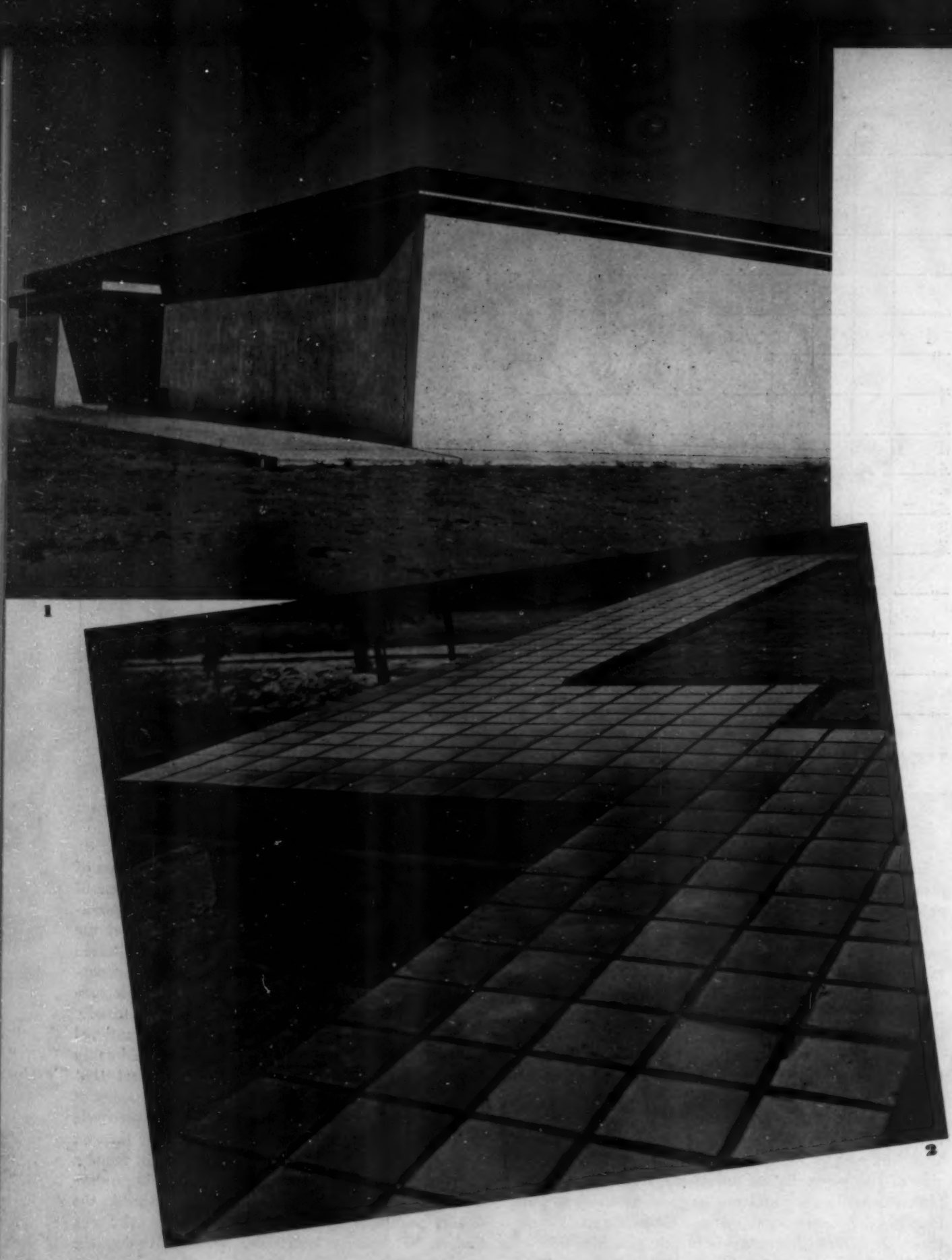
Fig. 2. Comparative Injection and Compression Manufacturing Costs

In the production of any plastic part selection of the process of molding the piece depends on certain predetermined factors. In other words, the item to be molded can utilize either the injection or compression method of molding and in many instances it is optional which procedure is chosen. What then are the factors which determine this choice? Economy is usually the prime essential, but there are other limitations, so let us investigate some of these comparative elements.

In the first place, the choice of material dictates the type of processing it is to receive. For example, if it is decided that a thermoplastic compound must be used, then injection molding is usually the method decided upon in order to gain maximum economy. Such selection, however, is limited to a certain extent by the size of the piece, for as previously stated, injection platen capacities are still not as great as those to be found in the conventional presses. Generally speaking, though, a thermoplastic article is able to utilize injection molding as the process for production. Secondly, there is the article which, due to certain requirements has to be made, let us say, in either a urea or phenolic material. In such a case there remains no alternative but to mold the part in the standard type of compression press.

The final case pertains to the item where selection of the material to be used is optional. It is this type of work which raises the question as to the most economical method of manufacture. Where selection of the material is of no consequence, proponents of injection molding often see no reason whatsoever for even considering any other method. In support of their contention they point out that the molding time is usually at least one-sixth of that utilized by the conventional method, and also that the mold costs are considerably lower. Furthermore, they bring out the fact that additional savings can be enjoyed by the salvaging of thermoplastic scrap. It is indeed true that the cycle time is much shorter on an injection machine than on any other type, and this advantage permits the use of a smaller capacity mold to gain an equivalent in production. There is only one saving, however, either in the smaller investment in dies, or a reduced piece price on a similar die capacity basis. So far as salvaging the scrap is concerned, this enters into the comparative costs distinctly in favor of the injection molder, although the amount saved is by no means 100 percent.

Were the material costs of ureas and phenolics the same as those of acetate, acrylate, polystyrene, etc., there would be no case (*Please turn to page 76*)



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Admitting light while retaining privacy, molded Styron blocks form the translucent skylight, seen from above **2**, of the bath house of the Midland swimming pool. Block construction is visible along edge of the roof **1**. Individual units pictured **3** show lips on each side for fastening to framework. Suggested for both exterior and interior surfaces, colorful blocks are being manufactured of Styron and Ethocel by The Dow Chemical Company

Construction Units Appear

Small, light, plastic blocks are being used experimentally by architect Alden Dow at Midland, Michigan

HOMES of the not too far distant future are destined for some revolutionary and logical changes according to predictions made by Alden B. Dow, Michigan architect, who has already gained nation-wide recognition for his modern functionally designed homes. Alden Dow envisions houses constructed almost entirely of plastic materials as a development of the near future. There will be no cracked walls in the homes constructed of these plastic materials because surfaces will be broken up into small units and sealed together with an elastic material, thereby allowing the natural movement of the building frame.

These small units will be of geometric form, combinations of which will form the design of the building. That is, dimensions will be in terms of units rather than feet and inches. Doors will be so many units high and wide, windows will be merely transparent units, while ventilators, radiators, light fixtures, radios and other accessories will be available in sizes interchangeable with these units. It will be easy to add to these new buildings because one system of construction will apply throughout. An addition will merely require so many standard unit frames and the necessary units to cover it and line it.

Other advantages claimed for these plastic materials include their good insulation against heat and electricity. Houses built of them promise to be cooler in summer and warmer in winter. In addition they will constitute an extremely low fire hazard, and be resistant to most acids. Plastic blocks need no seasoning. They will not, like wood, be attacked by insects, nor like most other materials, be subject to decay and disintegration. "In building with them, wastage—heretofore a big cost factor—will be eliminated," states Mr. Dow.

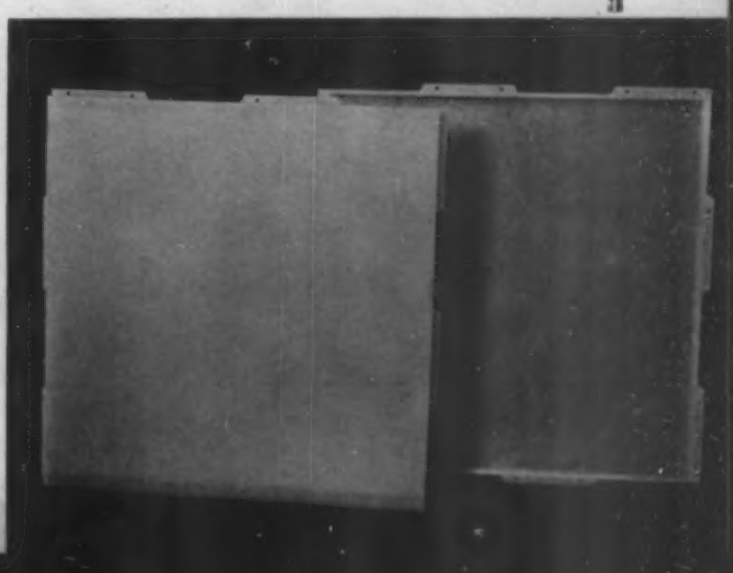
These and many other advantages of using plastics for building purposes have been indicated for some time but the difficulties of molding large pieces suitable for use in this field have, until recently, hindered extensive application in this direction.

However, a new plastic block, designed and patented by Mr. Dow, overcomes this difficulty by taking advantage of it. Working on the theory that a small construction unit has even more advantages than a large one, he created a block, one foot square, a size that is easily molded. Such a block gives the architect a smaller unit with which to work and thus opens up for him a greater number of possibilities in the treatment of construction problems than he would have in working with larger units of other materials. It is excellently suited for all types of building but is especially well adapted to the creation of homes of functional design.

The block is less than $1/8$ in. thick with a $1/2$ in. lip on each side. Each lip is equipped with two flanges containing two nail holes. Blocks are mounted by fastening them to a framework which has been previously constructed. Flanges are so arranged as to intermesh with each other on the frame, giving a continuous backing for the caulking compound. In building with these blocks both an exterior and an interior wall is made with an air space between. The crevices between the blocks are sealed with caulking after all have been mounted on the framework.

Many additional advantages are also claimed for these plastics as building materials. Besides opening up new possibilities in design that can be achieved with the small unit, plastic blocks are light and easy to handle, ship and mount. Their adaptability to different needs in construction largely eliminates the necessity of using other materials. Transparent panes taking the place of glass for windows would admit just as much light and in addition be practically unbreakable. In cases where it is desirable to supply light without visibility from the outside, the translucent material would be used and wherever it is necessary to shut off all light, opaque blocks could be used. Where desired, walls and roof may be translucent, filtering out the hot infrared rays and allowing the purifying ultraviolet to enter; or where it is preferred, allow the infrared rays to pass. A further development of this same idea will be a plastic which will change these filtering properties with changes in temperature. That is, on cool days, heat producing infrared rays will pass through them while on warm days it will be reflected.

The translucent blocks offer real possibilities both for homes and office buildings. (*Please turn to page 70*)



Firm Adhesion in New Finishes

by GORDON H. ROBERTSON*

NEWLY developed finishes for plastics offer for the first time such outstanding improvements in appearance, adhesion, and permanence that they are destined to affect considerably all previous methods for producing plastics in color. Numerous plastic users have experimented with organic coatings—paints and enamels—ever since color gained its real impetus a few years ago. The chief reason is that there is a substantial saving to the manufacturer who applied color in the form of an organic coating on the cheaper brown or black molding compound. Other advantages claimed are: A plastic in color at a lower cost than by using a molding compound in the desired color; greater flexibility on the production line; simplified inventory; an entire production run could be made in the less costly brown plastic material and finished up in any colors in current demand.

Up to the present, the chief drawback came from the sad failure of ordinary baking finishes to adhere. Hypothetical savings were sometimes offset by wholesale rejections on the production line due to chipping. Customers grew wary, as did buyers, when the enamel failed to adhere to the plastic.

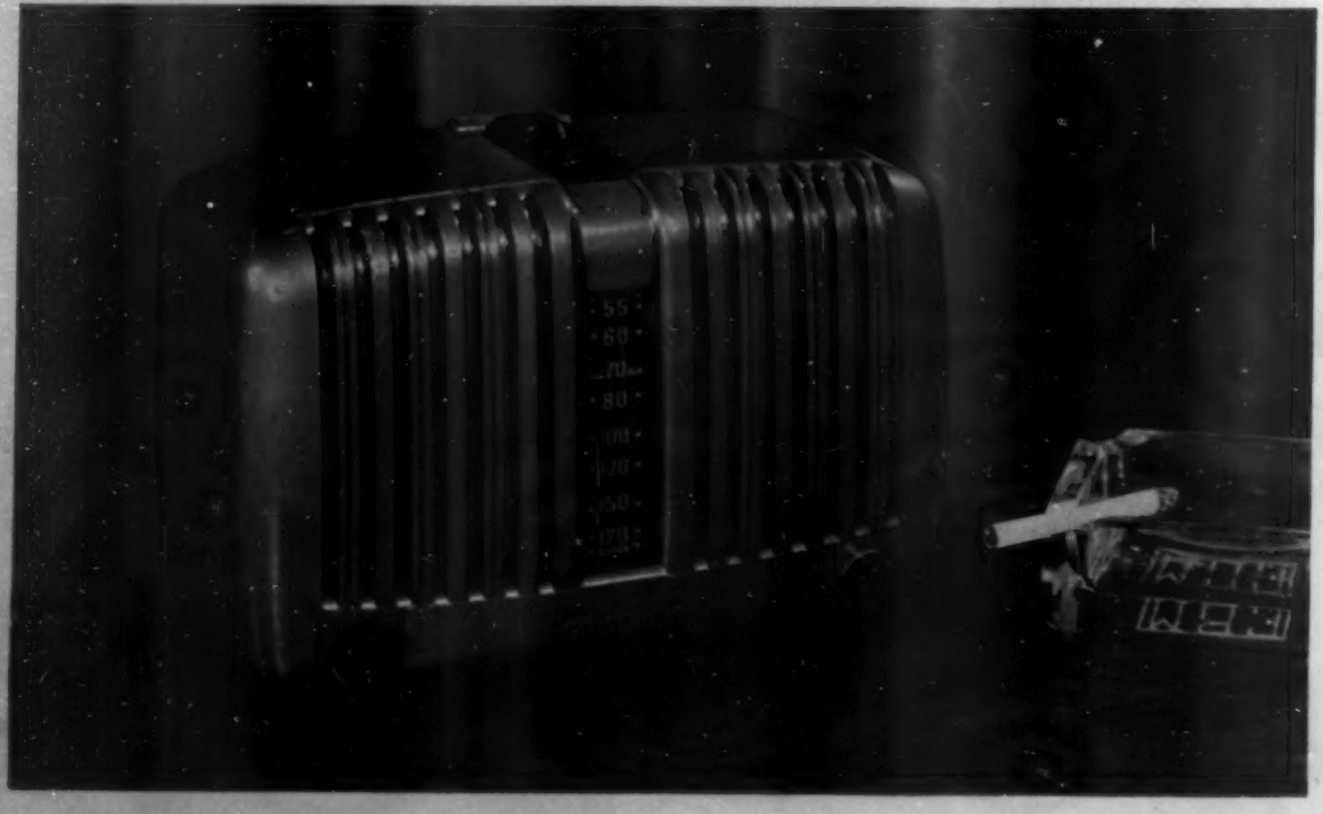
Since the new finishes overcome the weakness of former types, and save appreciably in production costs, they will undoubtedly prove a boon to those using plastics. In addition, they are more handsome than former finishes and make possible opalescent effects and strikingly beautiful colors which can be adopted in accordance with consumer demands.

The new finishes referred to are both synthetically evolved baking enamels. They are designed for spraying. One type offered is a pure color (or non-opalescent) enamel. The other is an opalescent type, which means fine metallic particles are added to increase richness, depth of tone and appeal. It is available in a wide variety of brilliant color shades. Both finishes produce a distinctly *non-painted* look. The opalescent finish is believed to be the first of this type that could be baked without some degree of flooding and consequent mediocrity of appearance.

* Mgr., Product Finishes Div., The Sherwin-Williams Co.

The rich deep color of this attractive Crosley table model radio is economically achieved by spraying the plastic housing with either Kem Plastite or Kem Bakolescent enamel—new organic coatings. The cabinet shown below was molded of Bakelite by Kurz-Kasch, Incorporated

COLOR PLATES, COURTESY THE SHERWIN-WILLIAMS CO.



Kem Bakolescent enamel adds bright color to the molded plastic non-heat-conducting handle on this General Electric iron. Metallic particles in this opalescent coating improve resistance to wear and perspiration

Tests made by several large manufacturers have demonstrated the fact that these finishes withstand severe abrasion without marring or chipping. One test consisted of slamming a steel panel face down against the corner of a mold where it was found most chipping formerly occurred. The new finishes withstood a blow sufficiently hard to dent the steel panel.

While it is true that a baking operation might tend to cause an exudation of greasing material to the surface of the plastic, thus interfering with the adhesion of the finishing coats in a few cases, it has been found possible by simple variations in the enamel formulations to overcome this hazard. The basic smooth hardness of many plastics also has seemed an obstacle to good adhesion in some few cases, but this, too, is easily overcome by an adjustment in the formulations of the enamel.

Chemical resistance ratings for the new opalescent type finishes referred to are given as: (a) salt—good; (b) acids—good; (c) cold caustic—good; (d) hot caustic—(180 deg. F.) softens film and attacks opalescent pigment, causing darkening.

No special problems should be encountered normally, in the use of these materials. They are easy to handle and spray application is recommended in all cases. The spray gun and nozzle used are important. Suitable types are available from the manufacturers of a number of the standard brands of spray equipment. The brands mentioned in the following paragraph are used only as a means of identifying types required.

The recommended procedure for applying the opalescent type finish is as follows:

1. Reduction: 10 percent, with reducers specified by manufacturer.
2. Equipment:
   A. Suction cup.
      (1) De Vilbiss Gun MBC or AV *F* or *FF* nozzle and needle No. 30 or 32 cap.
      (2) Binks Gun (Thor No. 7) 33 D Fluid nozzle and needle 36 SD cap.
   B. Pressure or gravity feed.
      (1) De Vilbiss Gun MBC or AV *F* or *FF* nozzle and needle No. 30, No. 20, or No. 76 cap.
      (2) Binks Gun (Thor No. 7) 33 D Fluid nozzle—needle 36 SD or 33 PD cap.
3. Method of application:
   1st coat—Light mist coat (for bond).
   2nd coat—Medium wet covering coat applied immediately over mist coat.
   3rd coat—Light mist coat (for opalescent effect).
   NOTE: High air pressure should be used to obtain the maximum break up—75–110 lbs. on the gun; approximately 5–10 lbs. on fluid.
4. Baking schedule:
   A. 45 minutes to one hour at 250 deg. F. Lower temperatures are not recommended. Higher temperatures are O.K. if kept within reason—approximately 300 deg. F. being the top. High temperatures result in color changes and loss of gloss.
5. Opalescent colors available: light blue, teal blue, rich brown, silver, gunmetal, red, gray, silver green, and taupe.

The finishing schedule for the non-opalescent type is as follows:

1. Reduction: 10 percent, with reducers specified.
2. Application: Spray two medium wet coats at spraying pressure of from 100 to 110 lbs.
3. Baking: 45 to 60 minutes at 250 deg. F.
4. Colors available: red, ivory, blue green, peacock green, dusty blue, medium yellow, medium blue, medium green.

PLASTICS IN REVIEW

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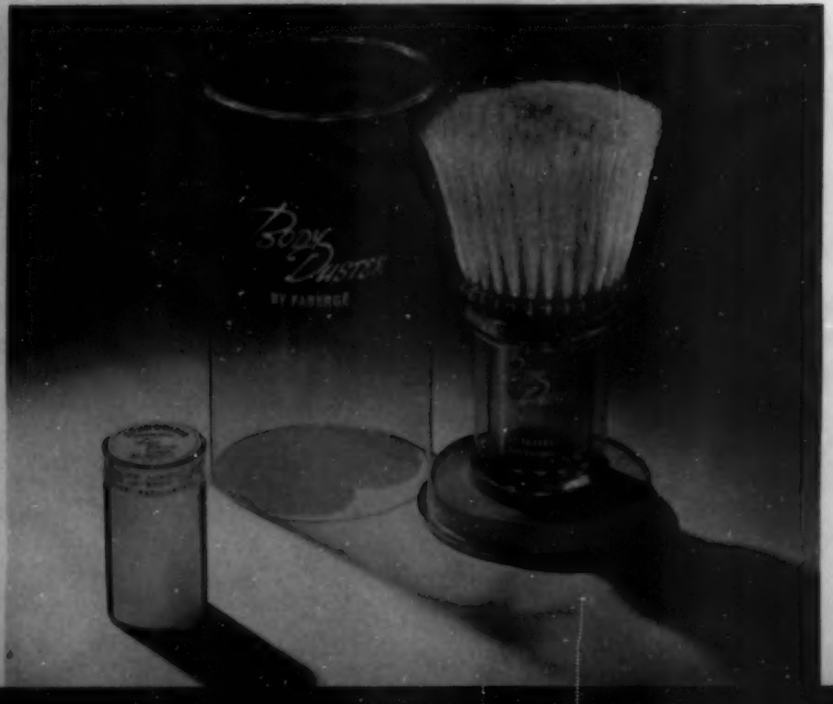

1 Traditional chess pieces, beautifully carved from translucent cast acrylic, add zest to an age-old game. Hand turned from red and white Plexiglas rods by W. L. Oppenheimer, these chessmen are durable, pleasant to touch and reflect interesting lights and shadows

2 Convenient, space-saving, the Everlight desk set, combining calendar pad with lighter attachment built in the base, lessens confusion of desk top essentials. Plastic Products, Inc., molds the base of Bakelite for Eveready Calendar Mfg. Co. Plain memorandam pages or bridge pads are available for home use

3 Serve several glasses without spilling—Sifon-Gauge pours one exact drink, stops a few seconds and repeats. Cut-away section shows the assembly of five molded pieces, three metal tubes and the cork. American Molding Co. mold plastic parts of Bakelite urea and Plaskon for Van Gauge, Limited

4 Knockabout model Cafex vacuum coffee maker has a lightweight, one-piece Durez upper bowl for regular kitchen duty. Specially formulated to withstand boiling water without imparting taste or odor, the plastic does not affect flavor of the brew. Matching handle is heat-resistant. Manufactured by Hartford Products Corporation

5 Stretch in comfort—unique Elasti-Glass garters, belts and braces yield to body pressure but return to shape slowly, without "snap." Water- and perspiration-proof, these novel accessories are made from tough, flexible vinyl-derived sheets, developed by Carbide and Carbon Chemicals Corp. Marketed in bright colors by S. Buchsbaum & Co. Transparent acetate tops the packages

6 Dainty Body Duster by Faberge, has a hollow handle of Marblette Crystle holding the powder which is fed through a perforated brush-back. Brush sits upright, when not in use, covered by transparent canopy of Monsanto Vue-Pak, used also for powder refills

7 Two auto keys are slipped in or removed from this compact case by a twist of the wrist. Slight pressure on the end ejects key for instant use. A practical premium item, with trade names stamped in gold or silver, the case is molded of brightly colored Tenite by Ward Plastic & Rubber Company

8 Smartly designed watch or double ring box, handy for re-use purposes, was molded by Norton Laboratories, Inc., for Warner Jewelry Case Co. Etched ivory Plaskon top is hinged to fit the black Durez base in perfect alinement

9 Smooth trim housing, contrasting colored volume control knob and dial of this tiny General Electric radio were molded of Textolite by the G-E Plastics Department

10 Astronomical symbols—Saturn for salt, a comet for pepper—top Skyway Shakers. Polished chromium squares are set into white Beetle bottoms which can be removed for filling or cleaning. Manufactured by Chase Brass & Copper Co., Incorporated

11 Impressionistic Times Square scene, etched on clear Lucite panels, decorates a removable folding partition in the Woodstock Hotel, New York. The base is blue Formica. Light-weight, this ornamental screen was designed by Myers, Minott Co. and etched by Pierre Bourdelle with standard power tools

12 A gay note in winter and spring ensembles, Burnt Sugar leaves and links are bunched into necklaces, brooches and bracelets shimmering with warm, golden color. George F. Berkander molds this "tortoise shell" jewelry of Lumarith for D. Lisner & Company

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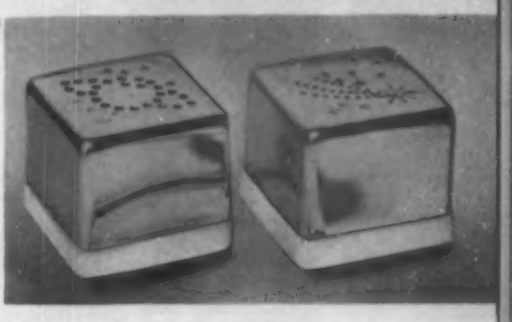

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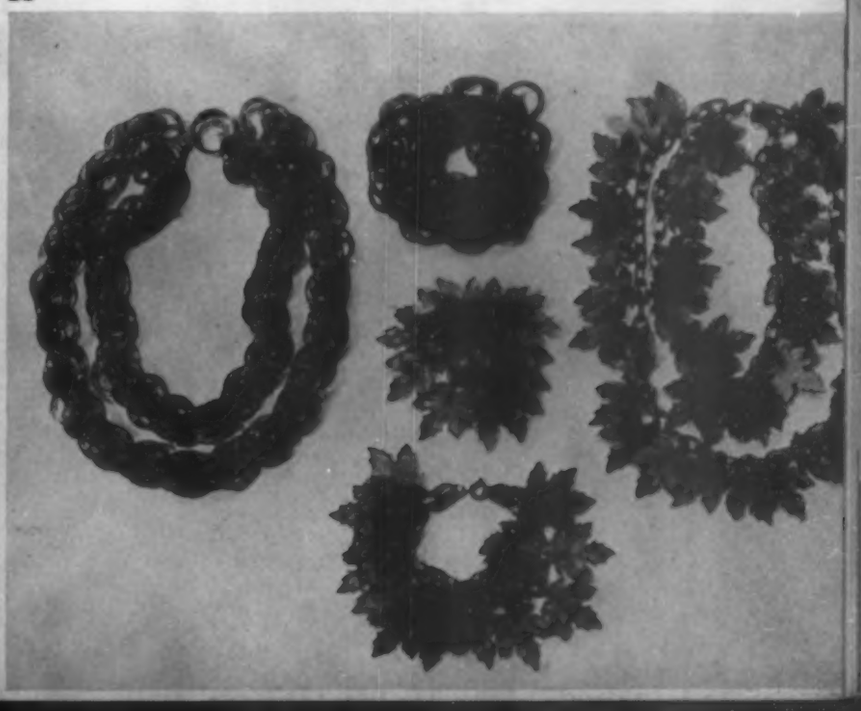

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13 For feminine miscellanea, dainty "carry-all" by Henriette, Inc., holds vanity essentials and cigarets in separate compartments. Small and lightweight, the rectangular case is molded of clear Lucite by Belmont Molded Plastics, Inc., in jewel tones of sapphire, emerald and ruby to blend with any costume

14 Print by ear—Fink-Roselieve's Audible Timer, manipulated by hand, may be set in the dark by merely flipping the switch to "focus" or "expose." Motor-operated hammer, striking like a metronome, counts off the seconds for exact timing. The compact unit is housed in Bakelite phenolic molded by Boonton Molding Company

15 Adaptable for premium or advertising purposes, handy boxes are molded by Bridgeport Molded Products, Inc., for Etched Products Corp. Metal tops in various designs and colors strikingly contrast with the smooth black phenolic bases

16 Vitalator, a hand vibratory machine designed by Robert Heller for A. C. Gilbert Co., has a sleek, molded plastic motor case set on a polished chrome base. T. F. Butterfield, Inc., molds the housing of Durez and Bakelite

17 Heat-resistant handles, adjustment knob and base of this automatic toaster safeguard fingers and table tops. Simplified assembly and the good-looking rounded contours are effectively carried out in the base. Midwest Molding & Mfg. Co. molds plastic parts of Durez for Miracle Products, Incorporated

18 Top to toe, Umbrubber keeps you dry in rainy weather. Umbrella handle, molded of Monsanto cellulose acetate by H. Jamison, has two nifty compartments holding a pair of lightweight rubbers. Complete unit is distributed by Halstead & Gravenstine

19 Individual transparent acrylic trays, each slotted to hold an engagement and wedding ring, frame the sparkling beauty of the gems. Machined from Plexiglas sheet, they rest on grooved rods cast of this light-catching plastic. Designed and executed by Bayard F. Brogan

20 No bigger than a lipstick, miniature razors fit conveniently in purse or pocket. Modern Plastics Corp. mold cases of Tenite in bright colors

21 Plastic gears are used in many industries for long life and quiet service. The large gear, built up of laminated Textolite is for the timing mechanism in the Hudson car. The smaller Fabroil industrial gear is of resin-impregnated highly compressed cotton, held under compression by two metal shrouds. Both are made by Plastics Dept., General Electric Company

22 Little Scotch penguins on translucent Insurok medallions dramatize the sales message for Sears Roebuck's Coldspot refrigerator. Lettering and designs are laminated by the silk screen process. Rear illumination, diffused through a series of these panels, produces a novel, advertising display

23 Lightweight, portable Farnsworth radio has a smartly designed cabinet of ivory Plaskon with a handle of the same material. International Molded Plastics, Inc., did the molding

24 Deadly looking weapons, Lone Ranger cap pistols interpret youthful dreams of pearl-handled six shooters. Lumarith grips are molded by Kilgore Mfg. Co. with the famed cowboy and the Hi-Yo Silver cry silhouetted in contrasting color

For manufacturers' addresses write to the Editor, enclosing self-addressed stamped envelope for reply

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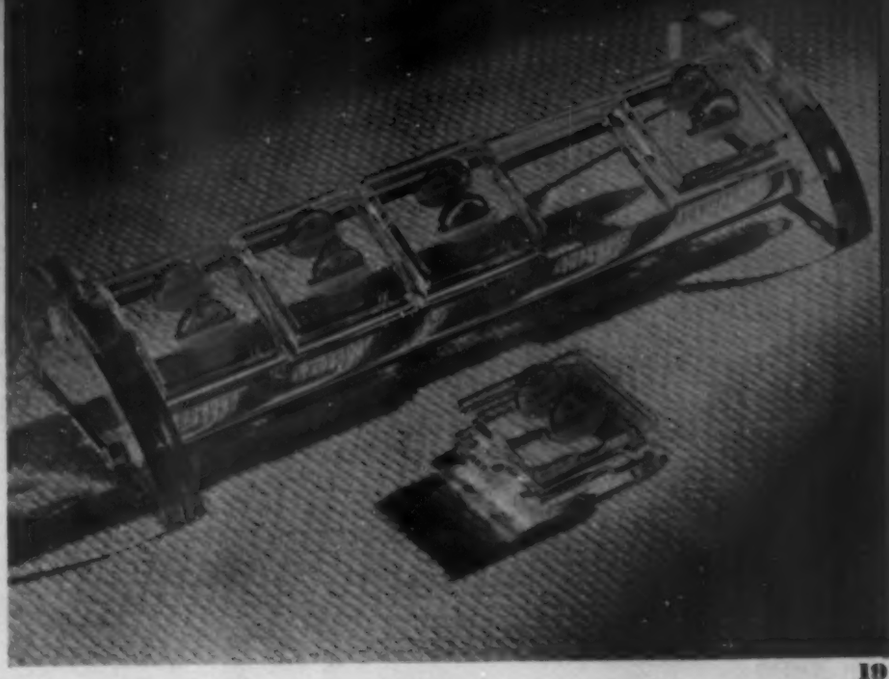
PLASTICS IN REVIEW



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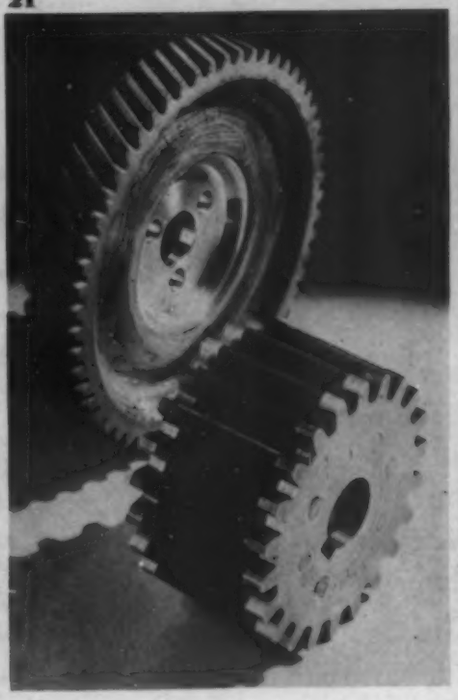

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BR . . . R . . . RR . . . RRR . . . RING ! ! !

And, for the effect that this old-fashioned doorbell signal had upon the nervous system, it might well have been an exploding firecracker.

Now the modern house is Rittenhouse-ed... fitted with musical chimes that do their announcing in pleasing, musical, mellow tones, delightful to the ear.

Pleasing to the eye, too, are these Rittenhouse Electric Door Chimes, for their housings are of Molded Plaskon. Rich, molded color that is a delight to the interior decorator and proud home-owner. Lovely, molded material that permits exact duplication of designers' creations, and enhances modern decorating schemes.

Have you fully considered *all* the advantages that Molded Plaskon can give to *your* product?

Molded Plaskon is smooth and warm to the touch. Though light in weight, it has great strength – will not chip, corrode, rust or tarnish. Its surface is hard, easy to keep clean. Water, oils and organic solvents will not stain or otherwise affect the beauty of Molded Plaskon. Being solid, molded color, the finish is permanent. Neither scratching nor abrasion impair its color value.

These are but a few of the many distinctive qualities that have made Plaskon the world's largest selling urea-formaldehyde plastic–and one of the most versatile.

Buttons and Buckles – Bottle Caps – Cosmetic Containers – Handles, Knobs and Dials for Motor Cars, Radios, Electrical Appliances – Lighting Reflectors – Switch Plates and other Electrical Wiring Devices –Toys and Novelties – these represent only a fraction of the wide variety of applications to which Plaskon has been adapted successfully and with profit.

An experienced Plaskon representative will give you recommendations for adapting Plaskon to your manufacturing and product-development needs. Write or wire – no obligation!

PLASKON COMPANY

Incorporated

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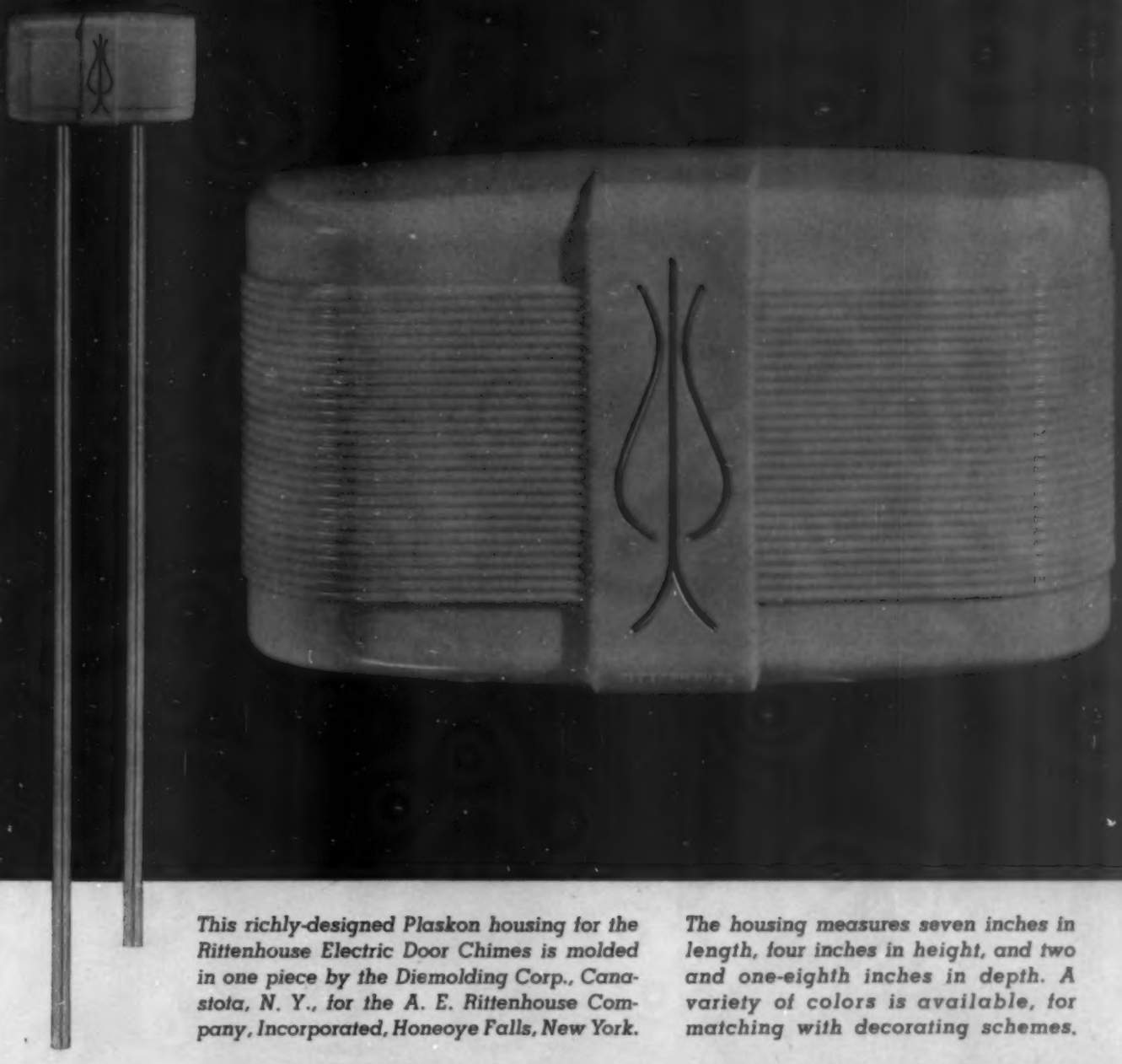
Canadian Agent: Canadian Industries, Ltd., Montreal, P. Q.

bells NO MORE!



This richly-designed Plaskon housing for the Rittenhouse Electric Door Chimes is molded in one piece by the Diemolding Corp., Canastota, N. Y., for the A. E. Rittenhouse Company, Incorporated, Honeoye Falls, New York.

The housing measures seven inches in length, four inches in height, and two and one-eighth inches in depth. A variety of colors is available, for matching with decorating schemes.

Trade Mark Registered

PLASKON

★ MOLDED COLOR ★

Light Without Glare—Redesigned

Engineering and optical requirements do not necessarily prohibit good modern design

1

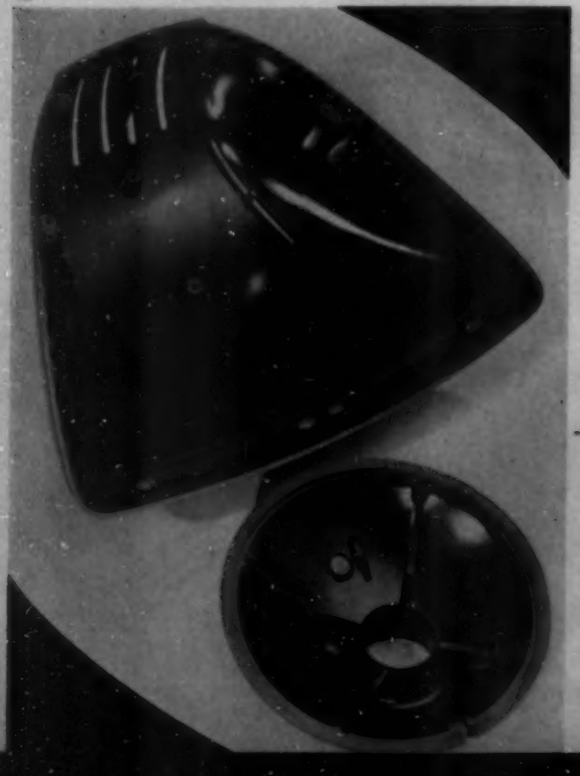
Less bulky, improved in light range, a new Polaroid Desk Lamp **1** to replace last year's model **3**, renews interest in glare-free illumination. Shade and base **2** molded of high-heat Bakelite by Associated Attleboro Mfrs., Inc., are reinforced by side and center ribbing for greater strength

A YEAR ago this month we printed a piece, describing the original Polaroid Desk Lamp, in which the author said, "The design of the lamp is quite functional, the points of optical importance having been positively determined before *appearance* was considered. The position of all edges against the light; the relations of light source to desk top and the relative positions of bulb, reflector and polaroid were all critical and had to be maintained." This proved to be a dreadful handicap to the physical appearance of this otherwise marvelous scientifically planned lamp.

The polaroid member of the lamp, as you probably know, is a cellulose film in which microscopic synthetic crystals are embedded, then *polarized*, or combed out, so that each light ray vibrates in a single plane. Only the vertical vibrations are permitted to pass, with the result that no glare occurs on any surface presented within its sphere of illumination. Therefore, it is possible to read and work in comfort and without eye strain because there is no annoying reflection of light.

Now, the lamp has been redesigned by Walter Dorwin Teague. The structure is greatly simplified and the working surface covered by the polarized illumination has been increased considerably. The use of a brushed, cast metal tubular column combined with a molded plastic shade and base indicate beyond any doubt that the functional limitations originally imposed did not necessarily prohibit good modern design. Moreover, the same engineering problems have been solved and optical specifications satisfied.

2



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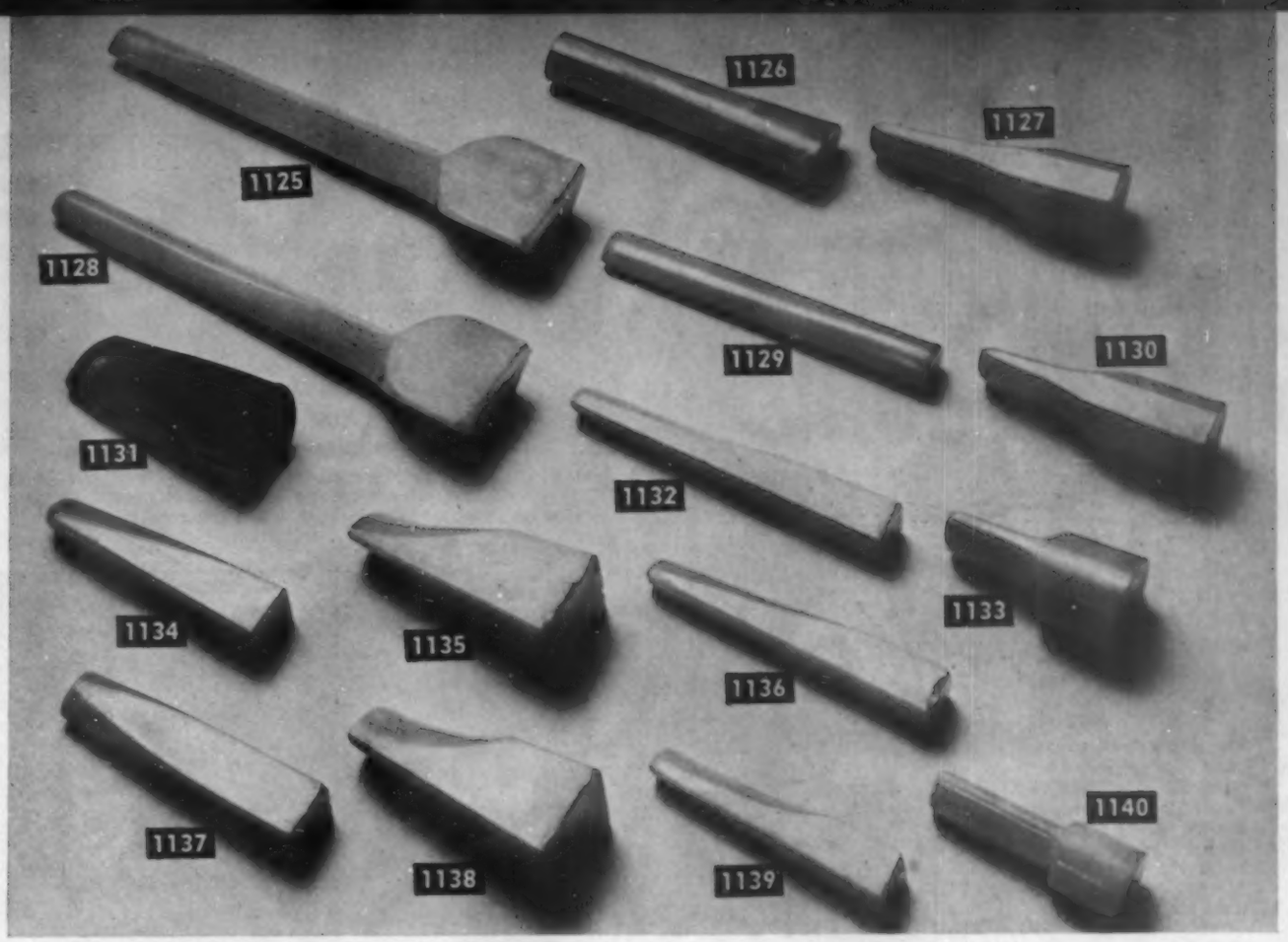


Sheets One to Fifty-Two, reprinted in book form, twenty-five cents in coin or stamps

Cast Resin Forms

SHEET NINETY-TWO

Designed for pipe stems, cigaret holders or cigar bits, these rough cast resin shapes are available from stock in a wide range of attractive colors, ready to be drilled, buffed, polished and finished for assembly. Please specify both item and sheet number when requesting manufacturers' names and addresses

---

1125. Pipe socket, 4 7/8 in. long. 20 pieces to the pound. Triangular-shaped at large end

1126. Pipe bit, 2 13/16 in. long. Oval shape 0.535 in. by 0.735 in. at large end. 34 pieces to the pound

1127. Pipe bit, 2 5/16 in. long. Octagon shape 0.720 in. at large end. 34 pieces to the pound

1128. Pipe socket, 4 13/16 in. long. 24 pieces to the pound. Triangular-shaped at large end

1129. Pipe bit, 3 3/16 in. long. Round shape 0.410 in. diameter at large end. 53 pieces to the pound

1130. Pipe bit, 2 1/16 in. long. Octagon shape 0.705 in. at large end. 35 pieces to the pound

1131. Cigar bit, 2 1/16 in. long. Round shape 0.815 in. in diameter at large end. 29 pieces to the pound

1132. Pipe bit, 3 in. long. 0.420 in. square at large end. 56 pieces to the pound

1133. Cigar bit, 1 9/16 in. long. Round shape 0.825 in. in diameter at large end. 40 pieces to the pound

1134. Pipe bit, 2 1/4 in. long. 0.485 in. square at large end. 50 pieces to the pound

1135. Pipe bit, 2 1/16 in. long. 0.810 in. square at large end. 25 pieces to the pound

1136. Pipe bit, 2 5/8 in. long. 0.420 in. square at large end. 61 pieces to the pound

1137. Pipe bit, 2 3/8 in. long. 0.500 in. square at large end. 47 pieces to the pound

1138. Cigar bit, 2 in. long. 0.815 in. square at large end. 24 pieces to the pound

1139. Pipe bit, 2 1/8 in. long. 0.420 in. square at large end. 83 pieces to the pound

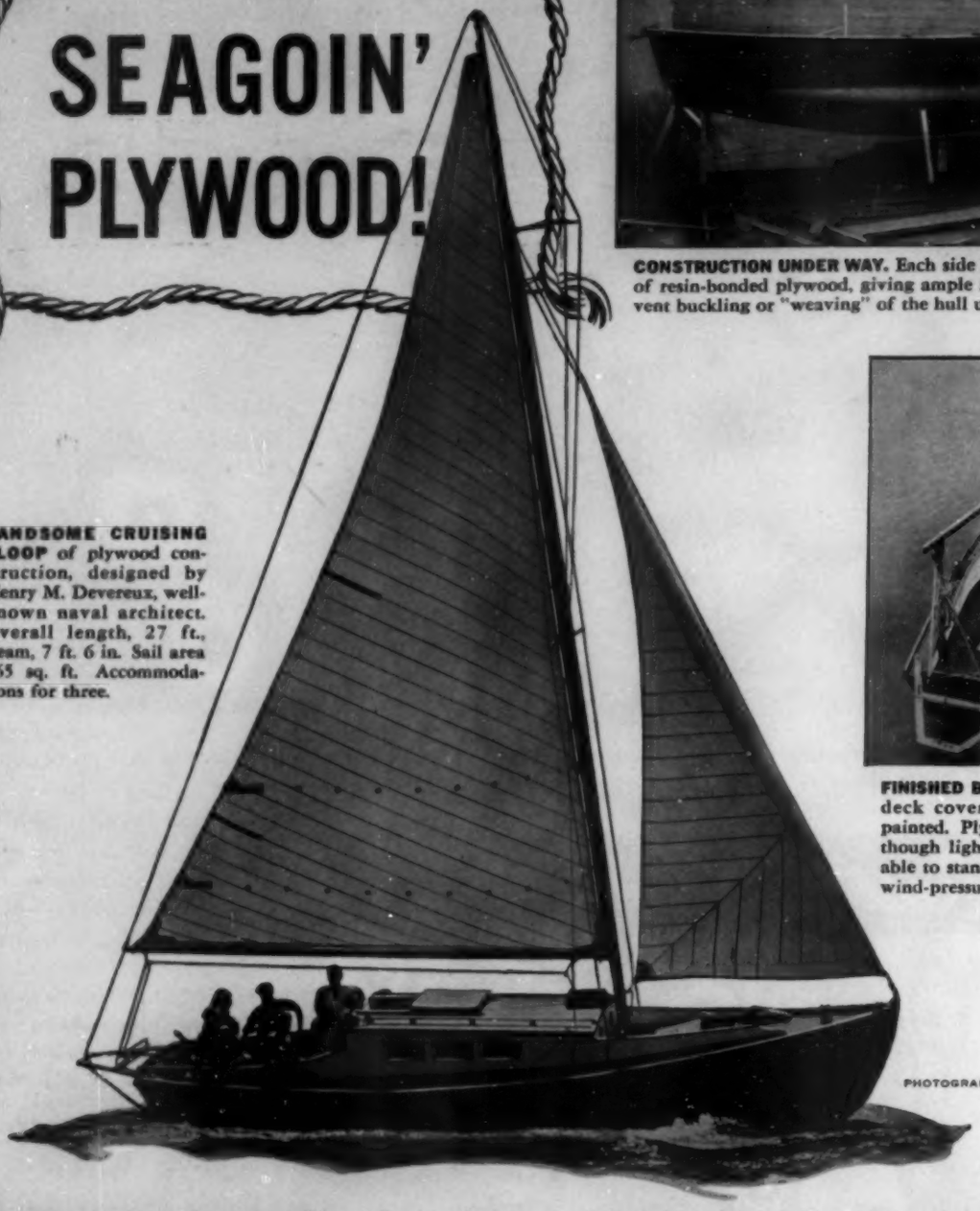
1140. Pipe bit, 1 11/16 in. long. Round shape 0.565 in. in diameter at large end. 72 pieces to the pound

Address all inquiries to Stock Mold Dept., Modern Plastics, Chanin Building, New York. All molders are invited to send samples from stock molds to appear on this page as space permits

SEAGOIN' PLYWOOD!

CONSTRUCTION UNDER WAY. Each side is one continuous sheet of resin-bonded plywood, giving ample reserve strength to prevent buckling or "weaving" of the hull under sail.

FINISHED BOAT, showing plywood deck covered with canvas and painted. Plywood deck and hull, though light in weight, are easily able to stand the terrific strains of wind-pressures on the rig.



HANDSOME CRUISING SLOOP of plywood construction, designed by Henry M. Devereux, well-known naval architect. Overall length, 27 ft., Beam, 7 ft. 6 in. Sail area 365 sq. ft. Accommodations for three.

PHOTOGRAPH BY M. ROSENFELD, N. Y.

HERE SHE BLOWS . . . the plywood boat! Long a theory—now a practical reality, thanks to hot-press phenolic resin-bonded plywood!

Time was, not so long ago, when plywood couldn't stand the gaff of such exposure and service. Even today the average plywood won't do this—or anything approaching it—but Durez phenolic resin glues will make a plywood that stands this service. Today such leading plywood manufacturers as M & M Woodworking Co. have found that Durez phenolic glues give plywood resistance to heat, cold and weather, immunity to fungus growth and warping. Even boiling water and live steam tests fail to break down the tough Durez bond!

It's an interesting subject—Durez bonded plywood, and we'll be glad to send you more information on its applications and manufacture if you'll just write Durez Plastics & Chemicals, Inc., 582 Walck Rd., North Tonawanda, N.Y.

A FEW OF THE MANY USES OF DUREZ BONDED PLYWOOD

AIRPLANE HANGARS	EXPORT AUTO BOXES
BAKING TRAYS	MARINE CONSTRUCTION
BILLBOARDS	PORTABLE BUILDINGS
CONCRETE FORMS	TRUCK TRAILERS
GARAGE DOOR PANELS	OUTDOOR FURNITURE

DUREZ PLASTICS & CHEMICALS, INC.

PLASTICS THAT FIT THE JOB

Denture Base Material: Acrylic Resins*

by W. T. SWEENEY**

AN INVESTIGATION of the physical properties of acrylic resins used as denture base materials was undertaken by the American Dental Association Research Fellowship at the National Bureau of Standards during the past year. In order to obtain a comparative idea of the value of the methyl methacrylate resin, use was made of a table of properties of various plastics published in October 1938 in MODERN PLASTICS. A study of the values in this table indicated that methyl methacrylate resin should be satisfactory for a denture base. Methyl methacrylate resin compares favorably in strength, density, molding characteristics and toughness with hard rubber, which has been the most used and probably the most satisfactory denture base material from both the standpoint of mechanical properties and clinical experience. It is the purpose of this paper to show how methyl methacrylate resin compares with denture base rubber and other materials used for denture construction. Tests were made on shelf life, curing, color stability, dimensional change, and such mechanical properties as strength and hardness. The materials investigated were obtained in the regular trade channels and are considered representative of the acrylic resins furnished the profession at the time of this investigation.

Shelf life of acrylic resins

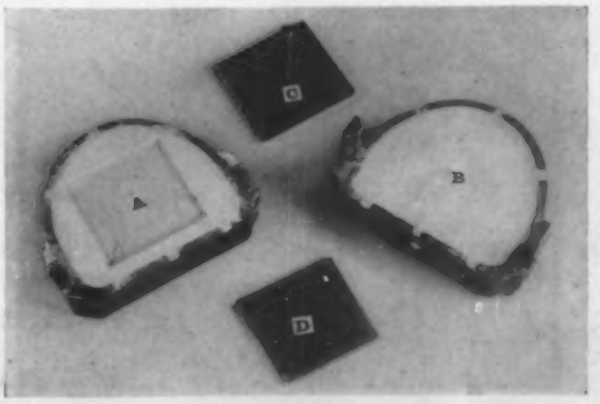
In order to determine the amount of time that the dentist may safely store units of acrylic resins, a series of tests on shelf life were carried out in which specimens of resin were stored at 5 deg. C., room temperature (approximately 25 deg. C.), 37 deg. C. and 43 deg. C., after which their moldability was determined. These temperatures were chosen as representative of temperature ranges encountered in shipping or in dental offices. Observations were made at various intervals of time, namely, 4, 8, 11, 15, and 45 days and $2^1/_2$ months. After each of these intervals of time the specimens of resin No. 3 (Vernonite) were packed in denture flasks to determine whether they were still sufficiently plastic to be adapted to the mold. The progress of the storage cure was very slow at the lower temperatures and very fast at the higher temperatures, with the result that this material was considered satisfactory for use after storing, as follows:

(1) For at least $2^1/_2$ months at 5 deg. C. (41 deg. F.)
(2) For 15 days at room temperature [approximately 25 deg. C. (77 deg. F)]
(3) For one week at 37 deg. C. (99 deg. F.)
(4) For one day at 43 deg. C. (109 deg. F.)

The specimens used in this series of tests were sealed in glass containers in order to prevent evaporation, and the rapid cure which takes place in the presence of oxygen. It was observed that specimens left in the atmosphere cured much faster than those stored in sealed containers. Therefore, units should be stored in the dark and in a closed container at the temperature ordinarily obtained in a household refrigerator, since oxygen, ultraviolet light, and heat are known to promote the polymerization of this resin.

Acrylic resin No. 1 (Crystolex), which is furnished in the form of a powder and a liquid, showed no apparent change in working qualities when stored at laboratory temperatures (25 ± 5 deg. C.) for more than a year. This is probably because of the presence of an inhibitor added to prevent polymerization at lower temperatures. The powder and liquid are mixed immediately before using and have a distinct advantage in shelf life over the materials furnished in cake form.

Plaster mold (A,B) and mold form (C) are used to cure denture resin test cakes (D)



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* Abridged from a paper read before the Full Denture Prosthetic Section of the American Dental Association, July 19, 1939, and published in the Journal Am. Dental Assoc. Vol. 26, Nov. 1939.

** Research Associate of the American Dental Association at the National Bureau of Standards.

Curing. One of the desirable features of these resins is the ease with which they can be packed and cured. The material furnished in the form of a plastic cake is packed similarly to rubber, that is, the cake is placed in a warm mold (approximately 77 deg. C. (170 deg. F.)) and the flask is closed in a compression clamp. The flask, after closing, is placed either in boiling water or in a vulcanizer for curing. The material will cure satisfactorily in 30 or more minutes at the temperature of boiling water. The plaster is easier to remove from the denture if it is cured in a vulcanizer at 138 deg. to 149 deg. C. (280 deg. to 300 deg. F.) for 30 minutes or more. The material is not sensitive to over-curing at these temperatures. When the resin is furnished as a liquid and a powder, the two are mixed in definite proportions to form a plastic mass which is packed into a warm mold much the same as the plastic cake. The model should be covered with tinfoil before packing in order to get the best results. After the cure is completed the denture should be allowed to cool to room temperature before removing from the flask, otherwise it may be distorted.

Color Stability. Specimens of the three acrylic acid resins were placed in an apparatus[1] used for studying the weathering effects of paints, varnishes, etc., and used previously by the author[2] on denture base materials. These specimens were exposed to the radiation of a carbon arc lamp and were sprayed with water. No change in color was visually detected after 29 hours' exposure. Observations on dentures in service confirm these accelerated tests.

Physical properties

The test specimens used in the determination of the physical properties were machined from cakes of material cured in plaster molds (Fig. 1). These cakes were approximately 65 by 63 by 4 mm when molded. The test specimens were machined to 65 by 10.0 by 2.5 mm, with a tolerance on the width and thickness of ±0.03 mm. They were finished smooth and flat. The materials were cured as described by the manufacturer's directions which accompanied the packages. The methods of making the tests will be briefly described and then the results will be compared with those obtained on rubber.

Transverse test. The specimens were stored in a constant temperature air bath at 37 ± 0.5 deg. C. for several hours before the tests were conducted. The instrument used in making the test is shown in Figs. 2–3. It was so constructed that the specimens could be tested by the application of a concentrated load to the center of a 50-mm span at 37 deg. C. The de-

[1] Walker and Hickson, Bur. Stand. J. Res. *1*, 1 (July 1928).
[2] Sweeney, W. T., and Schoonover, I. C., J. A. D. A. *23*, 1498 (Aug. 1936).

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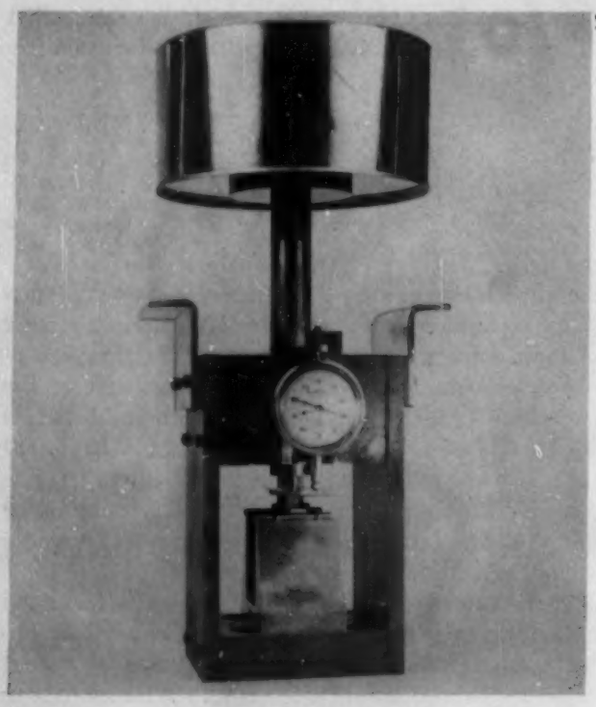

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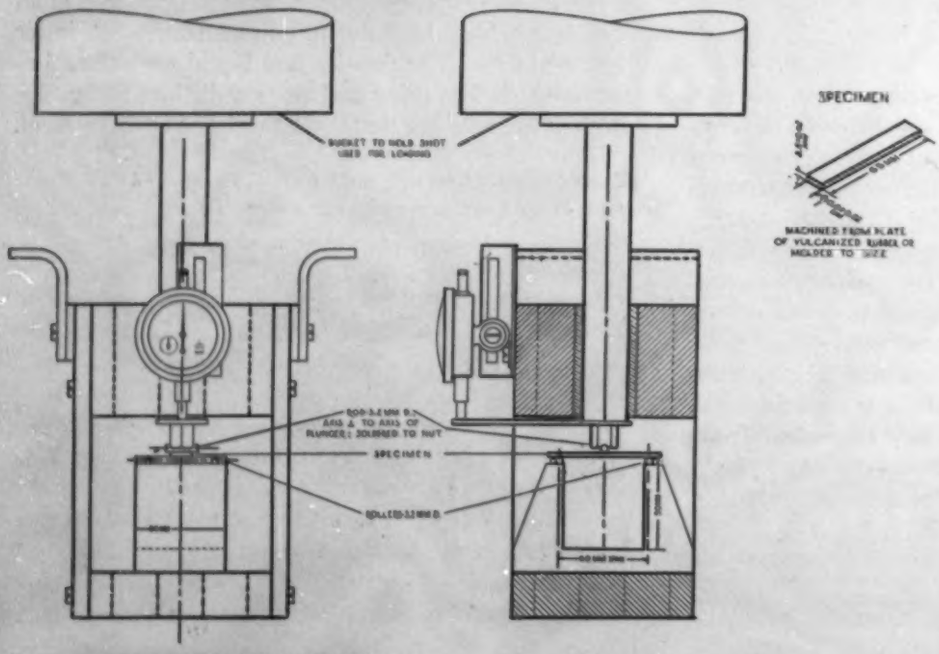

Fig. **2** pictures the instrument used to determine transverse properties of denture base materials. Diagram **3** (left) shows cross sectional views of the machine

TABLE 1

MECHANICAL PROPERTIES OF DENTURE BASE MATERIALS

Trade Brand	Material	Transverse Tests at 37° C.				Tensile Strength at 25 ± 3° C.	
		Deflection[1] at load of			Breaking Load		
		4000 Grams	5000 Grams	6000 Grams			
		Mm.	Mm.	Mm.	Grams	Kg/Cm²	Lb/In²
Crystolex (Detroit Dental Mfg. Co.)	Acrylic resin, No. 1	2.25	3.73	7.06	6100	575	8200
Lucitone[2] (L. D. Caulk Co.)	Acrylic resin,[2] No. 2	2.01	2.98	4 30	7000	685	9700
Vernonite (Vernon-Benshoff Co.)	Acrylic resin, No. 3	1.79	2.72	3.91	8000	641	9100
Ash's Dark Elastic	Olive base rubber	1.68	2.77	3.64	8000	555	7900
S. S. White's Veneer Light Pink, No. 3	Pink Veneer Rubber	1 38	3.36	4.46	6800	450[3]	6400[3]

[1] Deflection measured from initial load of 1500 grams.

[2] This material contained many bubbles when received and was difficult to mold into a solid cake free from holes.

[3] Tensile properties not on same rubber as other properties listed. (J. A. D. A. 23, 1500, August 1936.)

flection was measured on a sensitive dial indicator which was graduated in hundredths of a millimeter. An initial load of 1,500 gr. was applied to the specimen and the reading of the dial indicator was considered as the zero reading. Load increments of 500 gr. were gradually applied during a 30 second interval. Thirty seconds later the deflection was observed on the dial indicator. This procedure was repeated until the specimen failed. The results of the average of three or more tests are shown in Fig. 4, and Table 1. Data on base rubber similarly tested are included for comparison.

Tensile strength. The tensile strength of the materials (Table 1) was determined at room temperature in a 600 lb. Amsler hand-operated testing machine. The load was applied slowly and uniformly up to the stress necessary to rupture the specimen, which required about three minutes.

Hardness. The hardness of the materials was determined by the Knoop[3] indentation method using at 50-gr. load on a diamond pyramid. The diamond was in contact with the specimen for 5 seconds. The length of the impression from which its area was computed was measured with a micrometer microscope. The ratio of the load applied to the area of the indentation, expressed in kg/mm,² is shown in Table 2. The materials are arranged according to their relative hardness, the lower the number, the softer the material. Determinations were at room temperature (25–30 deg. C).

Comparison of mechanical properties. From a study of Fig. 4 and Table 1, a comparison of acrylic resins with olive base rubber and veneer rubber can be made. The transverse test data indicate that acrylic resins were not so stiff as a typical sample of olive base rubber. For example, acrylic resin No. 3 (Vernonite) shows a deflection curve that closely approximates the olive base rubber, while the other two materials are somewhat more flexible. The maximum strengths of the acrylic

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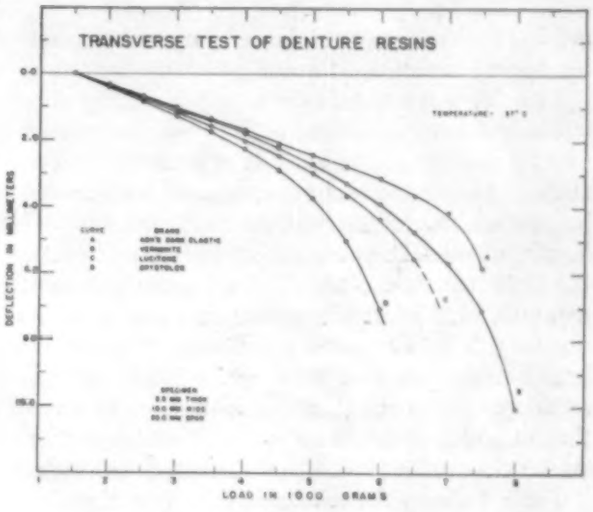


resins are, in general, of the same magnitude, ranging from 6100 to 8000 gr., while the breaking loads for olive base and veneer rubber were 8000 gr. and 6800 gr., respectively. The tensile strength of the acrylic resins was higher than that of the rubbers. The indentation hardness numbers (Table 2, page 46) are of the same order as of other denture bases. Numerical values for hardness are above those for the rubbers tested and below those for the phenol-formaldehyde resin.

Dimensional change

Shrinkage on curing. In order to determine the dimensional accuracy with which a denture base material may be expected to reproduce the dimensions of the model, the following method for measuring the linear shrinkage of denture base materials during curing was devised. The method consists in packing a sample of denture base material in a metal block of known dimensions. This block was invested in a dental flask similarly to the investing of a dental model. The material was treated in identically the same manner in

[3] A Sensitive Pyramidal Diamond Tool for Indentation Measurements, Knoop, F., Peters, C. G., and Emerson, W. B. J. Research Nat. Bur. Standards, Paper No. 1220, Vol. 23, p. 39 (July 1939).

TABLE 2

INDENTATION HARDNESS OF DENTURE BASES
(Knoop Method)

Trade Brand	Material	Indentation Hardness
		Kg./Mm.[2]
Resovin	Vinyl resin	13.0
Atlantic Gold Dust Rubber	Metal filled base rubber	13.2
Ash's Dark Elastic	Olive base rubber	13.4
S.S. White Maroon Rubber	Maroon base rubber	15.8
Ash's Gum Pink	Veneer rubber	16.4
Crystolex	Acrylic resin No. 1	17.5
Vernonite	Acrylic resin No. 3	17.6
Lucitone	Acrylic resin No. 2	20.3
Luxene	Phenol-formaldehyde resin	27.0

making the shrinkage test, in so far as packing and curing are concerned, as it would be in making a denture.

The shrinkage test block is shown in Fig. 5. The inside end faces on the cut-out portion of the block are parallel and flat. The block is constructed of stainless alloy of known thermal expansion. To determine the linear shrinkage of the denture base material: (1) the length, at room temperature, of the cut-out portion of the block was measured; (2) the length, at room temperature, of the test piece after curing was measured; (3) the difference between these lengths, divided by the length of the cut-out portion of the block (after a correction for its length change from room temperature to that at which the denture material ceases to flow was made) times 100, gives the shrinkage in percent.

Table 3 shows the results obtained on three acrylic acid resins and two denture rubbers. The shrinkage of acrylic resins varied from 0.47 to 0.56 percent; that of the olive base rubber was somewhat lower, 0.31 percent, and of the maroon rubber, 0.47. These determinations are considered accurate to ±0.05; therefore, the acrylic resins showed slightly higher shrinkage than the olive base rubber and approximately the same as maroon rubber. Different shapes of specimens of the acrylic acid resins gave no appreciable variations in results, while thin specimens of rubber gave slightly lower values than thick specimens. From the above observations it would be expected that an acrylic resin would give as satisfactory a fit as rubber. Both, however, would be somewhat undersize.

Another simple method was devised for measuring the shrinkage of plastic materials during curing. It consisted of etching lines on a Pyrex glass plate and curing the material in contact with this surface. The lines will be reproduced as ridges on the specimen. They may be measured separately on the plastic and the glass, or by placing the glass over the plastic and observing the difference between the lines on the plate and the ridges on the material. Uncured denture material was placed between two glass plates, one of which had lines on it. Only enough pressure was applied to insure contact between the plastic and the glass. This procedure offers a minimum resistance to the shrinkage of the material. Acrylic resin No. 3, by this method, had a shrinkage of 0.63 percent. This method seems very promising for the study of shrinkage of plastic materials.

Equipment for determining linear curing shrinkage of denture base materials consists of micrometer caliper (F) and stainless alloy curing block (C). Test pieces A, B are acrylic resins and D, E are denture rubber

5

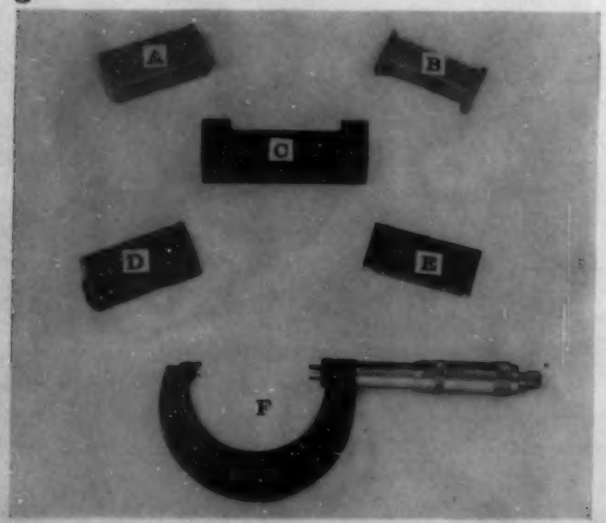


TABLE 3

CURING SHRINKAGE OF DENTURE BASE MATERIAL

Trade Brand	Material	Linear Shrinkage[1] Percent
Crystolex	Acrylic resin, No. 1	0.44
"	" " " "	.50
"	" " " "	.47
		Average .47
Lucitone	Acrylic resin, No. 2	.54
"	" " " "	.59
		Average .56
Vernonite	Acrylic resin, No. 3	.57
"	" " " "	.62
"	" " " "	.47
		Average .55
Ash's Dark Elastic	Olive base rubber	.40
" " "	" " "	.26[2]
" " "	" " "	.28[2]
		Average .31
S. S. White's Maroon	Maroon base rubber	.47

[1] These values are considered accurate to ±0.05.

[2] These specimens 4 mm. thick, all others approximately 10 mm. thick.

Dimensional change of acrylic acid resin denture. The effect of change in environment on warpage was studied on a denture made from acrylic resin No. 3 (Vernonite). The denture was prepared by the regular dental procedure and was stored for 60 days at a relative humidity of 32 percent in order to stabilize the resin to a constant condition. The denture was then stored in distilled water at 37 deg. C. for 27 days. During this 27-day interval it was frequently weighed and observations were made on marks on the denture to determine what change in dimension was taking place while the denture was immersed in water. The denture was then removed from the water and stored in air at 32 percent relative humidity. The change in dimension and the change in weight of the denture caused by wetting and drying are shown in Fig. 6. These curves show that the dried denture expanded when immersed in water and that the wetted denture shrank in air.

Before the denture was immersed in water, a gypsum model of its bearing surface was prepared. When the denture, after immersion in water for several days, was replaced on the model it could be clearly seen that it did not fit accurately. A study of the data (Fig. 6) indicates also that the cycle of dimensional change is reversible, that is, when the denture was alternately subjected to wetting and drying, it returned approximately to its original dimension.

The change in dimension observed on this denture indicates that occlusion should be adjusted when the denture has become saturated with moisture and that the denture should not be allowed to dry out thereafter.

Observations on dentures in service

In order to obtain some information on what changes are taking place in the material after the denture is placed in service, a few practical cases were constructed in cooperation with the Army Dental Corps, the University of Pittsburgh Dental School, and the Georgetown University Dental School. Models of the bearing surface of each of the dentures were made after the case was ready for insertion in the mouth. Marks were placed on the dentures on which observations with a microscope could be made for the determination of the dimensional changes. The models were stored at a constant relative humidity of 32 percent and were made from the same dental stone.

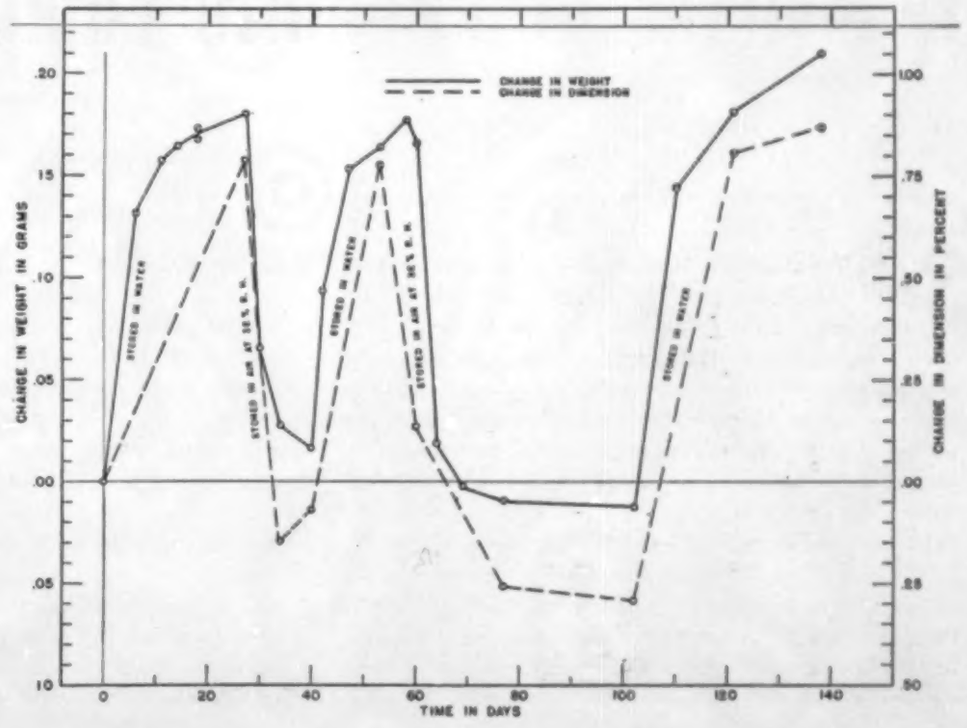
7

Gypsum model and denture used to study warpage of base materials

These dentures were examined from time to time by visual inspection and microscopic measurements to ascertain what changes in color and shape, respectively, were taking place. The fit of the denture was judged by placing it on the model and was considered satisfactory if there was no space visible between it and the bearing surface of the denture. A résumé of the observations is given in Table 4 (page 74). While these observations cover only a few cases, which may not be representative samples of dentures in service, they do give some very interesting information.

The study of these dentures indicates that a dimensional change of more than 0.5 mm occurred in one denture in the negative direction (Table 4, Case 12), while another showed a positive change of more than 0.25 mm (Table 4, Case 5A). (*Please turn to page 74*)

6



This record of dimensional and weight changes of an acrylic resin denture shows effect of storing it in water at 37 deg. C. and drying in air

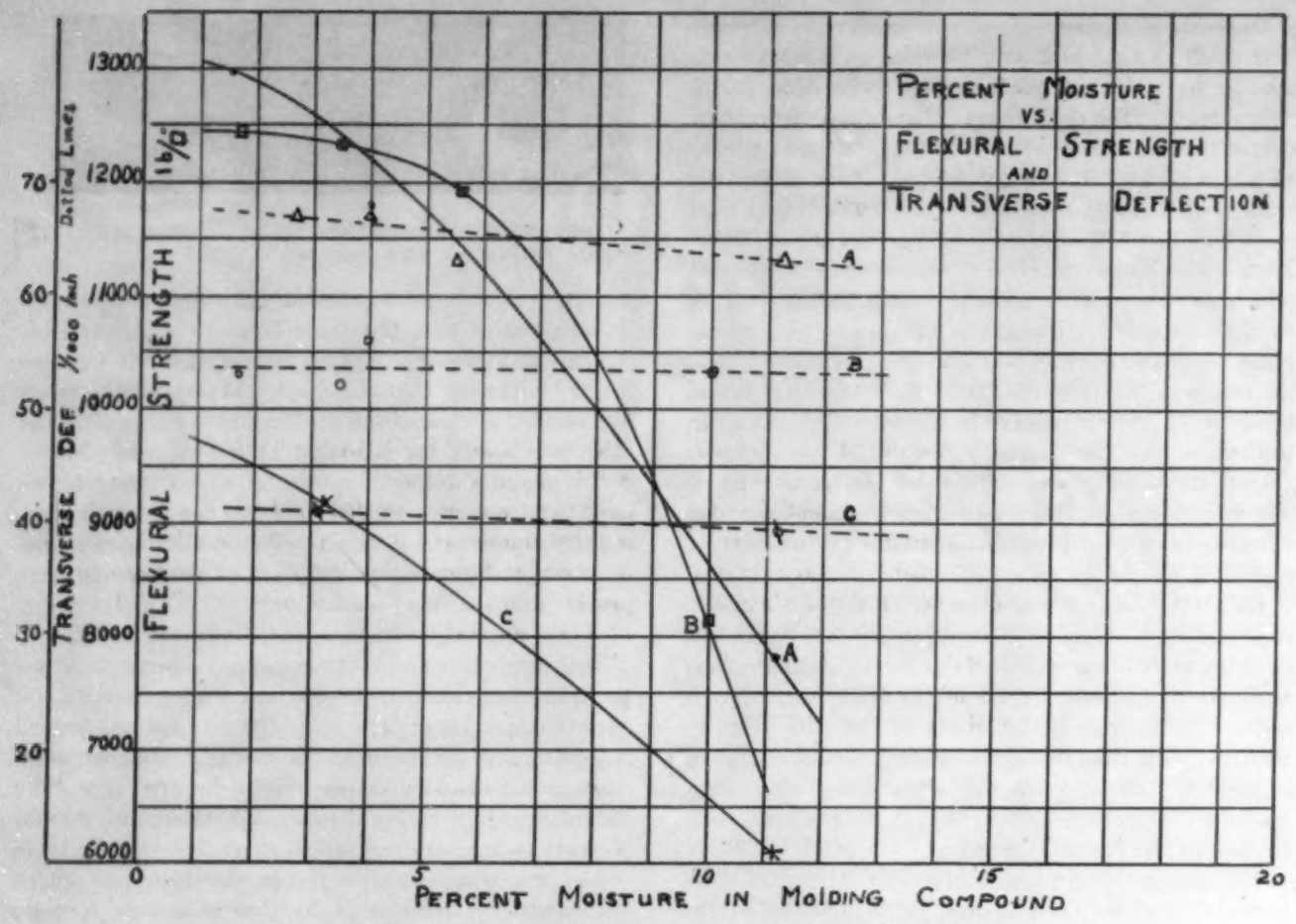


Fig. 1. Effect of variation in the moisture content (before molding) of three standard grades of phenolic compound on the flexural strength and deflection

Elasticity of Phenolic Compounds

by A. F. SHEPARD and L. A. SONTAG*

STANDARD grades of phenolics, all of which mold with reasonable ease, vary greatly in their elastic behavior. In a great many instances the molder has little interest in this property, speed of cure and general molded appearance being of primary importance. But in many other instances, such as those where an insert is used, where a molded part has to be sprung into position, or where design is such that strains are set up in a member, elastic properties may determine whether or not the molded piece will crack.

The use of an insert in a molded piece always sets up a strain in the piece. A picture of what this strain may amount to is given by the so-called *shrinkage* figures for standard grades of phenolics. The shrinkage is the difference in length between a cold, molded piece and the cold steel mold in which it was formed. The molded piece is always shorter than the mold by some 0.004 to 0.009 in. per inch of length, that is, the plastic contracts more on cooling than does the steel. If a steel insert is embedded in the plastic, the plastic will shrink around it and hold it tightly. This is usually an advantage, provided the strain set up in the plastic is not so great as to crack it. Whether or not the plastic will crack depends on the difference between the coefficients of thermal expansion of the plastic and the metal, the amount of cold flow, the degree to which the piece is cooled or heated, and finally upon the ultimate strength and the elastic properties of the plastic. (*Please turn to page 78*)

* Durez Plastics & Chemicals, Inc.

Improvements in Injection Molding Press Equipment

by H. J. WILLIAMS*

ANOTHER year of injection molding has presented many new problems. Some are concerned with the mechanics of molding equipment; some with the properties and characteristics of materials; and still others with the art of molding. Broader use of plastics has demanded better physical and chemical properties in the finished piece, and the materials manufacturers have answered with new or improved products. These newer materials have in turn necessitated improvement in equipment because of the following characteristics.

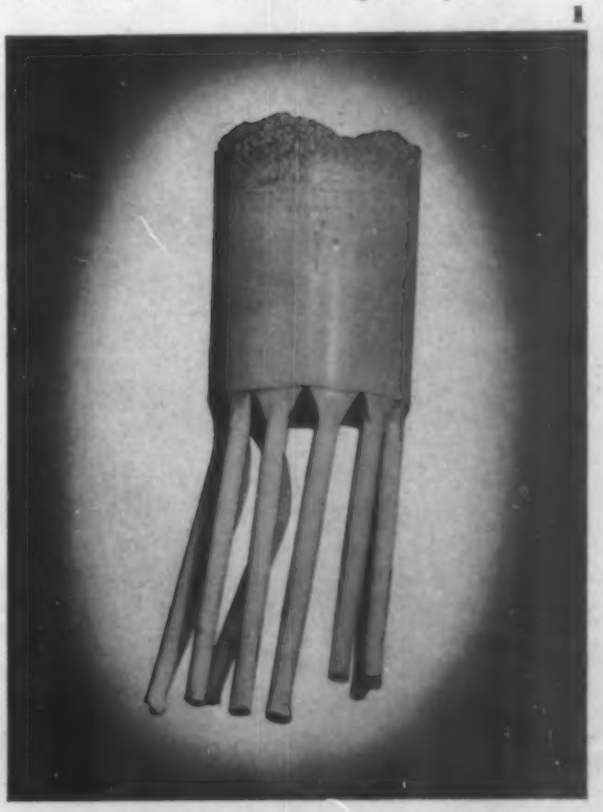
1. Some materials have higher melting or plastifying points, requiring better heat distribution.
2. Some materials have a more nearly definite solidification point, requiring that they be injected into the mold faster to prevent set-up before the mold is full.
3. Some materials melt into a very fluid state, and, on injection, work almost as pure hydraulics in exerting pressure on the mold and mold-locking mechanism.
4. Some materials in the raw state have a tendency to be brittle and fracture to fine dust. This dust, unless sifted out, or taken care of mechanically on the press, causes binding and scoring of the injection cylinder and piston.

These four demands on equipment have been answered satisfactorily by the manufacturers of presses, and work is constantly being done by them to make further improvements, especially on heating cylinders.

On some presses, heating cylinders are so arranged that the injection pressure is applied in the horizontal plane, using either a solid or a hollow type plunger. On other machines, the pressure is applied in the vertical plane. The hollow type plunger has proved to be far more efficient than the solid type for several reasons. The material is spread into a thin layer, which can be heated faster and more uniformly at lower temperatures than can a layer several times as thick, such as is encountered in the solid plunger type. This getting of the material into a thin layer is also of vital importance because the material itself is heated by conduction regardless of whether the metal in the cylinder is heated by oil, by conduction or by induction. A thin layer of plastic, heated from the inside as well as the outside, as provided in the hollow piston type, is more uniformly plastified and offers less resistance to passage through the spreader. This requires less piston pressure to effect the same work and deliver the same applied pressure at the nozzle.

The vertical type cylinder offers advantages over the horizontal type because the granular material is uniformly distributed around the spreader shaft, whereas in the horizontal type it lays on the bottom wall of the cylinder in one pile. The result is that there is less frictional resistance offered on the vertical plunger type, and pressure is exerted evenly on the piston, not tending to force it to one side. There is a second advantage in that (*Please turn to page 72*)

This piece, removed from a vertical heating cylinder, with a hollow type plunger, shows the semi-plastified state of the material entering the spreader



* Lester Engineering Co.

Chlorinated Rubber

by A. R. Olsen*

CHLORINATED rubber has long been known but only recently has it been produced with good color, clarity and unusual flexibility. A product meeting these requirements was developed a few years ago and is now produced in the new plant of the Hercules Powder Co. at Parlin, New Jersey.

Chlorinated rubber was first prepared in the middle of the nineteenth century, but it was not prepared commercially until 1917. At that time, Peachey employed a method of chlorinating a 4 percent solution of rubber in carbon tetrachloride obtaining a product with 65 percent chlorine. Since then, numerous improvements have been made in the manufacture of chlorinated rubber. The most recent is a chlorinated rubber with greatly improved original flexibility, which is retained on aging.

Chlorinated rubber is a completely saturated molecule containing approximately 67 percent chlorine. It is manufactured in five viscosities, namely, 5, 10, 20, 125, and 1000 centipoises—(all viscosities determined on the 20 percent solution in toluol at 25 deg. C. in a capillary tube viscosimeter.)

The 5-centipoise type is recommended for use in printing inks.

The 10-centipoise type for high solids chlorinated rubber lacquers and as a fortifying agent for alkyd resins and oleo-resinous varnishes.

The 20-centipoise type for general protective coating applications and also for fortifying alkyd resins and oleo-resinous varnishes.

The 125-centipoise type for concrete floor paints, paper lacquers, and adhesives.

The 1000-centipoise type for textile finishes and plastics as well as for other finishes requiring a maximum flexibility. Flexibility increases with viscosity.

Chlorinated rubber has a specific gravity of 1.64; its films are colorless, odorless, tasteless, and non-toxic. Chlorinated rubber has good mechanical and excellent electrical properties. It is stable up to 125 deg. C.; has excellent acid, alkali, mineral oil and moisture resistance; is soluble in cheap solvents; and is compatible with a large number of resins and plasticizers.

Chlorinated rubber was first used as a base material for chemical resistant maintenance-type finishes. For this application the chlorinated rubber must be modified with plasticizers, resins, pigments, and solvents. Resins and plasticizers are chosen for resistance to the corrosive conditions encountered. For this application, the chlorinated diphenyl plasticizers and the coal tar and phenolic-type resins give the best chemical resistance. In some cases where outdoor durability is also desired, some sacrifice of chemical resistance must be made. A typical chlorinated rubber chemical resistant finish for outdoor exposure would be plasticized with a combination of chlorinated (*Please turn to page 80*)

* Hercules Powder Co.

PHOTO, COURTESY MACK INTERNATIONAL MOTOR TRUCK CORP.

Chlorinated rubber added to the finish on this truck cab, imparts quick dry on a piece too large for a baking oven, and improves outdoor durability and chemical resistance

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Halliburton luggage handles molded by Allied Plastics, Inc.

TENITE HANDLES are a special feature of the new Halliburton travel cases. Designed to meet the highest standards of quality luggage, only materials of exceptionally light weight, durability, and beauty were selected for use.

Injection molded in a tortoise-shell variegation, the Tenite handles add richness to the appearance of the cases. They are comparable in strength to the airplane-metal cases—they will not chip, peel, or break when subjected to rough usage—and their lustrous finish will not tarnish or corrode with wear and exposure. The smooth surface and low heat conductivity of Tenite give the handles a warm, pleasant feel.

Tenite is an ideal material for almost every type of handle made. Tools, kitchen utensils, cutlery, plumbing fixtures, building hardware, and furniture are some of the many articles having Tenite handles.

Literature describing and illustrating the different uses of Tenite will be sent on request.

• • •

TENITE REPRESENTATIVES. *New York*, 10 East 40th Street. *Buffalo*, 1508 Rand Building. *Chicago*, 2264 Builders' Building. *Detroit*, 904-5 Stephenson Building. *Leominster, Mass.*, 39 Main Street... Pacific Coast: Wilson & Geo. Meyer & Company—*San Francisco*, Federal Reserve Building; *Los Angeles*, 2461 Hunter Street; *Seattle*, 1020 4th Avenue, South.

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Plastics Digest

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastic materials or use them. Requests for copies of the magazines mentioned should be directed to the individual publishers whose addresses will be mailed upon receipt of a self-addressed stamped envelope.

General

INDUSTRIAL RESEARCH IN 1939. W. A. Hamor. Ind. Eng. Chem. News Ed. *18*, 1–13 (Jan. 10, 1940). A trend of vast purport has been toward the utilization of plastics by the armed forces of every major nation. Military applications, definite and potential, include laminated materials in airplane construction, cast resins in guide lines on airplane carriers, luminescent resins in various military devices, tinted cellulose acetate windows for air raid protection, gun stocks of cellulose acetate and fabric-filled phenolic resins, cellulose acetate chutes for conveying ammunition belts from boxes to machine guns in airplanes, phenolic mouthpieces and containers for gas masks, impregnation of the fabric of gas masks with vinyl chloride resin as a protection against mustard gas, cellulose acetate in soldier's goggles, phenolic noses of anti-aircraft shells, and the possible application of Nylon as a parachute material. In three British fighting services the uses of synthetic resins are said to exceed 1000 in number. Other "sparkling epigrams of progress and luminous epics of achievement" in plastics are recorded.

SAFETY PLATE GLASS. G. B. Watkins. Glass Industry *20*, 448–52 (Dec. 1939). The safety features of laminated safety glass depend solely upon the plastic or strengthening layer placed between and bonded to the two lights of glass. The plastic and not the glass is the safety element. Polyvinyl butyral plastic will elongate approximately 300 percent. Until production costs of the resin and plasticizer are reduced with increased use, it is not feasible to use this plastic in thicknesses greater than 0.015 inch. However, tests show that by increasing the thickness of the vinyl butyral plastic from 0.015 to 0.025 inch, the safety features as measured in terms of resistance to impact, will be at least doubled throughout the temperature range from 0 to 100 deg. F. In addition to discussing the development of laminated safety glass, this article also presents information on the characteristics of heat-tempered glass.

CHEMISTS MAKE A NEW WORLD. F. Simpich. Natl. Geographic Mag. *76*, 601–32 (Nov. 1939). A popular review of developments in chemical industries, including plastics.

Materials and Manufacture

A NEW PLASTIC. Kunst.-Tech. und Kunst.-Anwendung *9*, 424–5 (Dec. 1939). The properties of Polyamid 6351, a resin manufactured by the Venditor Kunststoff-Verkaufsgesellschaft for injection molding at 230 to 240 deg. C., are listed. These include among others: specific gravity 1.13; flexural strength >14,000 lbs./in.^{2}; tensile strength 10,000 lbs./in.^{2}; dielectric constant 3.2 at 50 cycles, 3.3 at 800 cycles, and 3.6 at 1,000,000 cycles; power factor 0.010 at 50 cycles, 0.015 at 800 cycles, and 0.022 at 1,000,000 cycles; volume resistivity direct $>3 \times 10^{13}$ ohm-cms., after 5 days at 80% relative humidity 1.5×10^{13} ohm-cms., and after 2 months in water 1.3×10^{9} ohm-cms.; and surface resistivity direct $>3 \times 10^{13}$ ohm-cms., after 24 hours in water 1.7×10^{9} ohm-cms., and after 2 months in water 0.3×10^{9} ohm-cms. Water absorption resembles that of natural proteins and amounts to 300 mg. per 100 cm.^{2} surface area in 7 days. (This material is believed to be related chemically to the resins used in this country for the production of Nylon and Exton. These resins are not true polymers, i. e., there is no polymerization of unsaturated carbon compounds, such as occurs in the formation of polyvinyl, polystyrene, and polyacrylate plastics. It is suggested that these resins formed from the condensation reaction of amines and acids be called "amkyd" resins, in accordance with the terminology adopted for the condensation products of alcohols and acids, which are known as "alkyd" resins. G. M. K.)

COPOLYMERIZATION. H. Barron. Brit. Plastics *11*, 317–21, 328 (Dec. 1939). By this method profound modification of the properties of vinyl compounds has been made possible, producing materials akin to thermosetting resins on the one hand and to rubber on the other. The process is specific, i. e., two vinyl monomers will not inevitably produce a copolymer. Styrene and vinyl acetate will not copolymerize. Maleic anhydride does not form polymers, but will copolymerize with styrene. Excess of styrene in the latter mixture will go into the copolymer, but when excess of maleic anhydride is present, only that amount chemically equivalent to the styrene will be taken up. Copolymerization will undoubtedly be an important factor in future developments in plastics.

MELAMINE RESINS. Brit. Plastics *11*, 326 (Dec. 1939). Directions are given for the preparation of resins from melamine by condensation with formaldehyde in the presence of an aromatic compound, such as phenol. One of these can be cast in molds and hardened in 24 hours. (Melamine resins for molding are being sold in Germany under the trade name "Ultrapas." They are being used in Italy for creaseproofing fabrics. Melamine resins have not yet been marketed in this country, but it may be significant that the American Cyanamid Co. has recently announced the availability of the chemical intermediate required for their manufacture, namely, dicyanodiamide.)

COPOLYMERIZATION OF MALEIC POLYESTERS. J. B. Rust. Ind. Eng. Chem. *32*, 64–7 (Jan. 1940). Resins can be prepared by polymerization of diethylene glycol maleate polyesters or their copolymerization with vinyl compounds. They offer promise of utility as molding, laminating, casting, lacquer, and adhesive resins. The greatest commercial possibilities of the copolymerized resins lie in their rapidity of cure and ability to be made water-white or in unlimited colors.

FATTY-ACYL-MODIFIED RESINS. A. E. Ralston, R. J. Vander Wal, S. T. Bauer, and E. W. Segebrecht. Ind. Eng. Chem. *32*, 99–101 (Jan. 1940). Resins were prepared from dicyclopentadiene, coumarone, and indene hydrocarbons modified by acyl groups, such as stearoyl, oleoyl, and linolenoyl. These high-molecular-weight acyl-modified resins are of particular interest because of their high flexibility and water resistance, which should make them useful for waterproofing leather, textiles, and cellulose products.

RATE OF TRANSFORMATION OF RESINS OF PHENOL-FORMALDEHYDE TYPE. N. J. L. Megson and H. M. Paisley. J. Soc. Chem. Ind. *58*, 213–5 (June 1939). Results obtained by an improved acetone extraction method show that the rate of heat-reactivity of resins is in the order: phenol > *m*-cresol *m*-5-xylenol. This is the reverse of the order found by turbidity time determination which is considered to be unreliable for use as a measure of the usefulness of a resin for molding. Cresol mixtures give resins which have minimum values of soluble ingredients between 10 and 12 percent after curing.

Testing

WEATHER STABILITY OF PLASTICS. R. Nitsche and E. Salewski. Kunst.-Tech. und Kunst.-Anwendung *9*, 416–20 (Dec. 1939). Two-year exposure tests of specimens molded from German phenolic and urea resins are described. The properties measured at intervals were flexural strength, impact strength, water absorption, and dimensional change.

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U. S. Plastics Patents

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VINYL RESINS. G. O. Morrison and A. F. Price (to Shawinigan Chemicals Ltd.). U. S. 2,179,051, Nov. 7. Making colorless polyvinyl acetal resins in which the aldehyde component is acetaldehyde or a higher aldehyde.

SANDPAPER. R. C. Benner and N. P. Robie (to Carborundum Co.). U. S. 2,179,487, Nov. 14. A heat-hardened bond for abrasive grains on a support comprises a lignin-phenol-aldehyde resin.

VINYL RESIN COMPOSITION. C. H. Alexander (to B. F. Goodrich Co.). U. S. 2,179,973, Nov. 14. Compounding polyvinyl chloride with a silicate of an alkaline earth metal or of lead or silver.

POLYSTYRENE FILMS. E. C. Britton, H. B. Marshall and C. W. Davis (to Dow Chemical Co.). U. S. 2,179,975, Nov. 14. Dissolving polystyrene in an aromatic hydrocarbon containing 1–5 percent dioxan, and making films from the solution.

RUBBER SUBSTITUTES. M. Mueller-Cunradi and W. Daniel (to I. G. Farbenindustrie Akt.-Ges.). U. S. 2,180,082–3, Nov. 14. Polymerizing butadiene or a derivative thereof, or vinylcarbazole, in presence of solid, highly polymerized isobutylene to make rubber-like polymers.

TRANSLUCENT SCREEN. E. H. Land (to Polaroid Corp.). U. S. 2,180,113–4, Nov. 14. A transparent plastic containing interspersed particles of a polarizing substance is used as one layer in a translucent glass screen.

PLASTICIZER. L. P. Kyrides (to Monsanto Chemical Co.). U. S. 2,180,281, Nov. 14. Plasticizing cellulose esters with a mono-N-cyclohexyl arylsulphonamide.

TERPENE RESIN. J. H. James (to C. P. Byrnes). U. S. 2,180,418, Nov. 21. Resinifying terpene hydrocarbons by oxidizing with atmospheric oxygen, then converting the oxygenated product to a resin.

GASOLINE-PROOF RESIN. E. E. Mayfield (to Hercules Powder Co.). U. S. 2,180,535, Nov. 21. Making a gasoline-proof varnish by cooking a pine resin product with a drying oil at 565–600 deg. F. in presence of a zinc, lead, tin, manganese or cobalt compound.

VENEER ADHESIVE. R. G. Peterson (to G. H. Osgood). U. S. 2,180,547, Nov. 21. A glue for wood veneers is made with an initial artificial resin condensation product, compounded with woodflour and sodium (or potassium) nitrate.

CASEIN PLASTIC. J. Delorme (to Geo. Morrell Corp.). U. S. 2,180,626, Nov. 21. Treating acid casein with a benzyl compound and an alkali metal carbonate to form a thermoplastic.

MASTIC TILE BASE. Frank W. Corkery. U. S. 2,180,729, Nov. 21. Use of a highly elastic coumarone-indene dimer (free from higher polymers) in drying oil compositions used as a base for mastic tile.

MOLDED ARTICLE. H. M. Dent and A. J. Norton (to General Plastics, Inc.). U. S. 2,180,934, Nov. 21. An article having two outside faces and a core has 15–20 percent hardened phenolic resin in the core, while surface layers contain 60–65 percent resin reinforced with a web of fibrous material.

PHENOLIC RESIN. E. F. Fiedler (to General Electric Co.). U. S. 2,180,981, Nov. 21. An acid condensation process for making a permanently fusible phenol-aldehyde resin.

ALKYD RESIN. H. A. Hampton and E. B. Robinson (to Imperial Chemical Industries, Ltd.). U. S. 2,181,054, Nov. 21. Modifying alkyd resins with rosin, maleic acid and a drying or semi-drying oil.

THERMOPLASTIC RESIN. P. H. Groggins, J. T. Stearn and B. Makower. U. S. 2,181,231, Nov. 28. Esterifying a polyhydric alcohol, such as glycerol, with a hydroxyaliphatic acid, then esterifying the free hydroxyl groups with a polycarboxylic acid to form a resin.

HEAT-STABLE RESIN. K. K. Fligor (to Carbide and Carbon Chemicals Corp.). U. S. 2,181,478, Nov. 28. Stabilizing vinyl chloride resins to heat by adding a metal stearate and an alkali metal formate or acetate.

LINER. D. M. Gray (to Hazel-Atlas Glass Co.). U. S. 2,181,481, Nov. 28. A composition for liners comprises a vinyl ester resin plasticized with 30–40 percent tricresyl phosphate and 2.5–4 percent petrolatum.

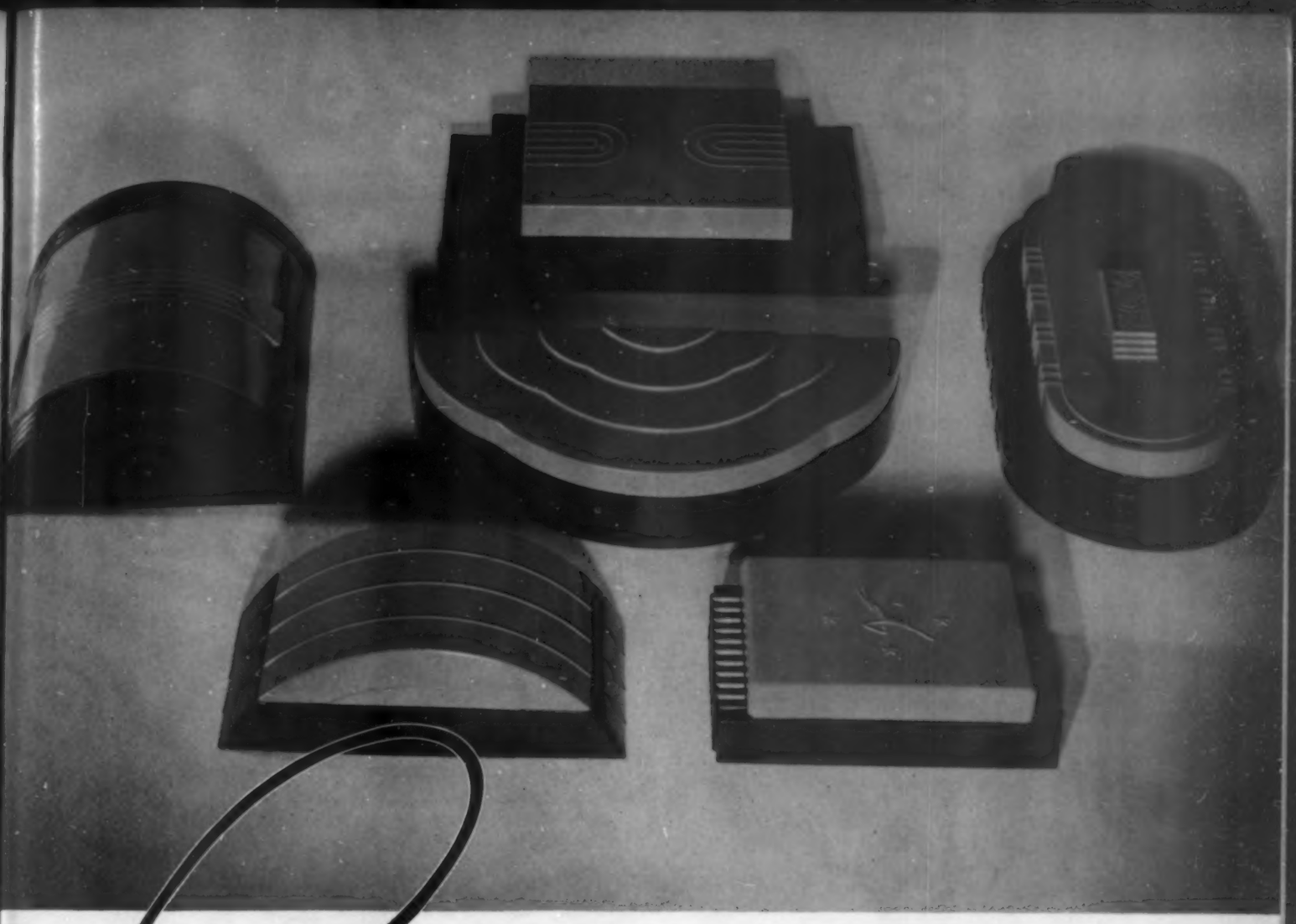
CELLULOSE DERIVATIVE PLASTIC. R. P. Russell (to Standard Oil Development Co.). U. S. 2,181,609, Nov. 28. Compounding cellulose esters with a viscous isobutylene polymer.

INSULATED WIRE. H. A. Winkelmann (to Marbon Corp.). U. S. 2,181,632, Nov. 28. Use of rubber hydrochloride, stabilized with a basic compound, as insulation where good electric properties must be combined with high resistance to water, oils, ozone and ultraviolet rays.

CLEAR RESIN. W. I. Patnode (to General Electric Co.). U. S. 2,181,739, Nov. 28. A hard, rigid, bubble-free resin comprising an interpolymer of styrene and 1 to 10 percent of allyl methacrylate.

HYDROCARBON POLYMERS. N. D. Scott (to E. I. du Pont de Nemours and Co.). U. S. 2,181,770–1, Nov. 28. Catalyzing the polymerization of styrene, or of 1,3-dihydronaphthalene, with an organometallic compound of an alkali metal.

CONTAINERS. H. Hoenig (to R. Collins, J. J. Sheridan and P. M. Scher). U. S. 2,181,786, Nov. 28. Making hollow articles and containers by spraying a synthetic resin powder into a hollow mold through a constriction therein, and curing the resin in the mold under fluid pressure. (*Please turn to next page*)



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Auburn's more than 60 years experience often results in profitable short cuts to quality. Precision die-making, extreme care in molding and a whole series of rigid inspections always insure the plus quality that means plus sales—whether it's a re-use package, a display, or a product itself of molded plastic. On *your* next molded plastic job, call in an Auburn man.

Established 1876

MOLDED PLASTICS DIVISION OF

AUBURN BUTTON WORKS, Inc.

AUBURN, N. Y.—New York, Chicago, Detroit, Cleveland, Rochester, Boston

VARNISH RESINS. H. H. Hopkins and F. A. McDermott (to E. I. du Pont de Nemours and Co.). U. S. 2,181,893, Dec. 5. Clear, homogeneous, fast-drying alkyd resins are obtained by condensing glycerol with phthalic anhydride in presence of a linseed oil acid and tung oil blend containing 10 to 60 percent tung oil.

MOLDED KNOBS. J. B. Tegarty (to Standard Products Corp.). U. S. 2,182,007, Dec. 5. Forming knobs from separate molded shells of plastic material with their inner portions rigidly joined together.

SILICON-MODIFIED RESIN. H. K. Nason (to Anderson-Stolz Corp.). U. S. 2,182,208, Dec. 5. Resins formed from p-alkylphenols and formaldehyde are modified with a silicon compound as silicon tetrachloride, alkylsilicon chlorides or the like.

ETHYLENEIMINE POLYMERS. H. Ulrich and W. Harz (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,182,306, Dec. 5. Making viscous to waxy products by polymerizing ethyleneimine.

CASEIN PLASTICS. C. Schwartz (to Hall Laboratories, Inc.). U. S. 2,182,357, Dec. 5. A plastic composition for use in coatings, sizes, adhesives and the like contains casein and a tripolyphosphate.

SAFETY GLASS. J. H. Sherts and B. J. Dennison (to Pittsburgh Plate Glass Co.). U. S. 2,182,358, Dec. 5. Apparatus for applying a resin to plate glass sheets, forming the resin into a smooth film by heat and pressure, and joining the sheets to make laminated glass.

TRANSPARENT FOILS. H. B. Smith and D. R. Swan, U. S. 2,182,359; H. B. Smith, U. S. 2,182,360-1-2; H. B. Smith and D. R. Swan, U. S. 2,182,363; E. K. Carver and B. E. Gramkee, U. S. 2,182,371. Dec. 5 (all to Eastman Kodak Co.). Imparting a rubber-like quality to polyvinyl acetal resin foils by blending the resin with a suitable plasticizer, specifically: butyl or isoamyl carbamate with dibutyl phthalate; or o-cresyl toluenesulphonate; or monobenzyl succinate; or bis-2-(beta-ethoxyethoxy)ethyl formal; or bis-2-(beta-butoxyethoxy)ethyl formal; or tripropionin.

THERMOPLASTICS. J. S. Reid; H. R. Husted (to Standard Products Co.). U. S. 2,182,388-9; 2,182,400, Dec. 5. Apparatus for surface polishing of shaped thermoplastic articles; an injection molding method in which converging streams of thermoplastic join at a zone in which the mold cavity wall is heated hotter than in other parts of the mold cavity; and an injection molding method in which the point at which converging streams of thermoplastic join is governed by controlling the temperature (rate of flow) of each stream.

POLYISOBUTYLENE PLASTICS. J. A. Anderson; Wm. I. Buckeridge (to Standard Oil Co. of Indiana). U. S. 2,182,512; 2,182,513, Dec. 5. In low temperature polymerization of isobutylene the molecular weight of the polymeric product is increased and the plasticity is improved by freeing the isobutylene from diolefins before polymerization; and in joining wax surfaces together the bonding agent (employed at ordinary temperature) is hydrogenated rubber or a plastic isobutylene polymer with molecular weight between 2000 and 15,000.

OILPROOF VARNISH. Wm. H. Butler (to Bakelite Corp.). U. S. 2,183,234, Dec. 12. The resin component of an oilproof varnish contains 1.5 to 5 parts of a thermoplastic (coumarone or novolak) resin and 1 part of a thermosetting phenolic resin.

CELLULOSE ESTER. H. A. Auden, H. P. Staudinger and H. M. Hutchinson (to Distillers Co., Ltd.). U. S. 2,183,317, Dec. 12. Plasticizing cellulose acetate and like esters with acetals containing at least 7 carbon atoms.

VINYLIDENE CHLORIDE POLYMERS. R. M. Wiley (to Dow Chemical Co.). U. S. 2,183,602, Dec. 19. Shaping vinylidene chloride resins by heating above the softening point, but not to the decomposition temperature, then suddenly chilling the resin and shaping it while in the supercooled state.

VINYL RESIN. A. W. Downes (to Carbide and Carbon Chemicals Corp.). U. S. 2,183,642, Dec. 19. Polymerizing vinyl acetate in methyl acetate solution in order to achieve a high degree of polymerization.

BUS BAR INSULATION. E. C. Homan (to Irvington Varnish and Insulator Co.). U. S. 2,183,811, Dec. 19. A vinyl chloride: vinyl acetate interpolymer, plasticized with tricresyl phosphate and chlorinated diphenyl, is used to coat waterproofed fabric insulation; the insulation will not drip at bus bar operating temperatures.

HOT PRESS MOLDING. V. H. Turkington (to Bakelite Corp.). U. S. 2,183,857, Dec. 19. Imparting porosity to articles molded from thermosetting resins, the pores being formed by an ingredient which expands during the molding operation but is not permitted to escape.

TRANSPARENT FOIL. H. B. Smith (to Eastman Kodak Co.). U. S. 2,184,155, Dec. 19. Transparent foil, made of polymerized vinyl butyraldehyde acetal, is plasticized with tetrahydrofurfuryl maleate.

OLEFIN RESINS. F. E. Frey and R. D. Snow (to Phillips Petroleum Co.). U. S. 2,184,295, Dec. 26. Continuously reacting olefins with sulphur dioxide in liquid phase to form an interpolymeric resin, soluble in liquid sulphur dioxide.

TRANSPARENT FOILS. B. E. Gramkee; N. S. Kocher and H. B. Smith; H. B. Smith; H. B. Smith and D. R. Swan; H. B. Smith (to Eastman Kodak Co.). U. S. 2,184,423; 2,184,-426; 2,184,442-3; 2,184,444; 2,184,445, Dec. 26. Transparent polyvinyl acetal resin foils are given rubber-like properties by being plasticized with tributyrin, alkylphthalyl ethyl glycolates, triamyl phosphate, triethyleneglycol diacetate, triethyl citrate or tetrahydrofurfuryl succinate.

LEATHER PLASTIC. W. C. Pierson (to National Products Corp.). U. S. 2,184,467, Dec. 26. Making a synthetic resin from vegetable-tanned leather fiber (emulsified by heating with phosphoric acid) by condensing with phenol and hexamethylenetetramine.

RECORD BLANK. H. E. Hofmann (to Union Carbide and Carbon Corp.). U. S. 2,184,524, Dec. 26. A sound record blank has at least its playing face made of a vinyl chloride, polystyrene, vinyl acetate or vinyl chloride:vinyl acetate resin.

PIGMENT CHIP. D. R. Wiggam (to Hercules Powder Co.). U. S. 2,184,539, Dec. 26. Colloiding pigments by milling with ethylcellulose at 100-150 deg. C. to form pigment chips with the pigment thoroughly dispersed in the colloid.

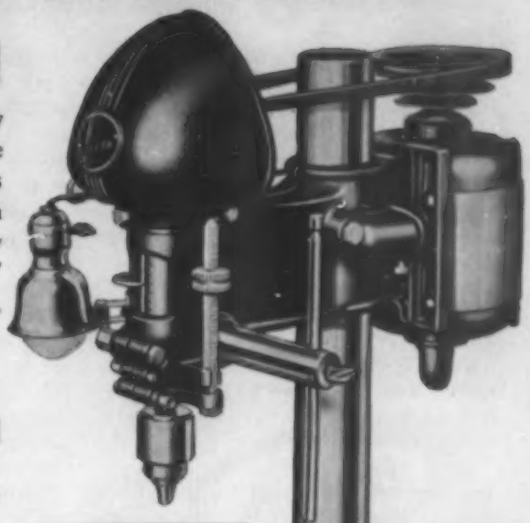
OINTMENT BASE. R. Beutner (to Parke, Davis and Co.). U. S. 2,184,575, Dec. 26. An ointment base which forms a film on the skin contains a phenol-aldehyde or phenol-ketone resin and a urea-aldehyde resin.

PROJECTION SCREEN. F. W. Jackman (to Warner Bros. Pictures, Inc.). U. S. 2,184,672, Dec. 26. Spraying several coats of cellulose ester on a matrix, applying a fabric border strip, spraying on several additional coats and finally stripping the dried cellulose ester sheet from the matrix.

"THESE DRILL PRESSES GAVE ME THE JUMP ON THE FIELD"

...and I can get them quick!

That's what a leading manufacturer told us recently. By utilizing batteries of Delta low-cost drill presses he was able to handle a series of light operations economically—reduce his costs materially—and announce new low prices that gave him a distinct edge on competition. Today—despite a greatly accelerated demand—Delta can give you, too, 11", 14" and 17" drill presses quickly—at prices from 1/3 to 1/2 of heavier, less efficient equipment.



Thousands of plants are using them

—for every type of drilling and tapping operation. The 14" bench type drill press with production type base illustrated to the right gives you: 1/2" drilling capacity in cast-iron, 4" spindle travel, drills to center of 14" circle, table 16" wide, 14" deep, 19 1/2" from bottom of chuck to table, table has 1 1/2 inch oil trough with 1/2" tapped drain hole at rear.

$59.85

No. 1011—Complete with ½" Jacobs Chuck, but without motor or switch.

Send for CATALOG

Mail coupon for latest Delta Industrial Power Tool Catalog. It contains specifications and prices of complete line of Delta Drill Presses plus details on individual parts from which you can make your own low cost assemblies.

DELTA INDUSTRIAL POWER TOOLS

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MANUFACTURING COMPANY
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619 E. Vienna Avenue Milwaukee, Wisconsin

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619 E. Vienna Avenue, Milwaukee, Wis.

Gentlemen: Please send me your latest Delta Catalog which contains specifications and prices of your complete line of Drill Presses.

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News

C. H. FRANTZ, CHAIRMAN OF THE COMMITTEE FOR the Spring Meeting of the Society of the Plastics Industry, announces the most interesting and delightful plans ever made for the annual meeting—a strictly stag weekend cruise, Friday through Monday, June 7 to 10, on a specially chartered ship, the *S. S. Alabama*, out of Detroit, Mich., to Charlevoix, Mich., and Mackinac Island, with golf on one of the finest courses in Michigan, dinner ashore Saturday night and a world of fun aboard ship.

All of this costs only $44.00 per person including transportation, meals, berth for three days, and prize fees. But to make the trip possible, it will be necessary to get 150 reservations (with checks for $44.00 each) before February 15, in order to complete arrangements for chartering the ship. If this number of reservations isn't forthcoming by February 15, according to the announcement, checks will be returned and other arrangements made. If more than 150 reservations are made by that date, there will be a proportionate refund.

Remember—this is the Annual Meeting for the election of officers and directors for the ensuing year. Send your check for $44.00, right now, to C. H. Frantz, Chairman of the Committee for the 1940 Spring Meeting, c/o Kurz-Kasch, Dayton, Ohio. You don't have to be a member of S.P.I. to enjoy this cruise. If you are actively engaged in the molding or manufacturing of plastics, you are cordially invited to come.

HERE'S AN OPPORTUNITY TO WIN FIFTY DOLLARS and christen a new plastic. Otto A. Hansen, president of the newly formed Cast Plastics, Inc., announces that the company is offering a cash award for a trade name, accepted by it, for a plastic of the phenol-formaldehyde casting type. Anyone, anywhere, may send in an unlimited number of suggested titles—there are no other rules. This contest closes March 15, 1940. Send your suggestion on a postcard addressed to Cast Plastics, Inc., 200 Sussex Ave., Newark, N. J.

PLASTICS AND THEIR USES IN THE AUTOMOTIVE Industry was the subject of a paper presented at the Annual Meeting of the Society of Automotive Engineers in Detroit on January 17 by Dr. G. M. Kline, Technical Editor of MODERN PLASTICS and Chief of the Plastics Section of the National Bureau of Standards. A chronological survey of the development of plastics in the United States was presented and the special properties and applications of each plastic in the automobile and airplane were reviewed. Advances in the art of molding by compression, injection, transfer, extrusion, and direct hydraulic methods were discussed. The recent emphasis on fully automatic molding with its attendant improvement in the quality of moldings and the intensive search for plastics suitable for structural parts were seen as important factors in guiding the progress of plastics in the near future.

The sound and color film *Modern Plastics Preferred* was shown at the conclusion of Dr. Kline's paper and was followed by a half hour's discussion period, in which several members of the automotive and plastics industries participated. The plastics which won awards in the 1939 Fourth Annual Modern Plastics Competition were exhibited before and after the technical session and elicited many favorable comments and queries regarding sources from the approximately 200 engineers in attendance.

FORMATION OF MINNESOTA PLASTICS CORP., custom molders, at 411 Broadway, St. Paul, Minn., is announced by Herbert R. Galloway and Leonard A. Holmberg, officers of the company. Present equipment is for injection molding.

INCREASING INTEREST IN DICALITE FILLERS, USED for a wide range of products from paints and varnish to plastics, rubber, paper dyes, cosmetics, leather, linoleum, etc., points to additional applications for many industrial requirements. These mineral (silica) fillers, according to a descriptive illustrated booklet issued by the Dicalite Co., are used to strengthen, stiffen and preserve; to increase durability and resistance to abrasion, heat and fire; to insulate electrically; to improve moisture characteristics and oil retention qualities, and for various other purposes.

As far as plastics are concerned, addition of these fillers is said to give greater bulking (more volume per pound), effecting better quality plastics at a reduced cost per finished unit. Increased strength, reduced brittleness, better color qualities, greater durability, improved heat, fire and water resistance and low electrical power factor are some of the advantages claimed to result from their incorporation in molded, cast or laminated plastics.

TINNERMAN STOVE & RANGE CO. REVEALS THAT due to the rapid growth of its Speed Nut division, it has found it necessary to completely discontinue manufacture of stoves and ranges, and announces the formation of Tinnerman Products, Inc., a new corporation which will devote all production facilities to the manufacture of speed nuts and speed clips. Officers of the new company are: Albert H. Tinnerman, president and treasurer; George A. Tinnerman, vice-president and general manager.

W. D. HAYLON, WHO FOR MORE THAN 4 YEARS HAS been publicity representative for the Pittsfield, Mass., works of General Electric Co., has been appointed advertising manager of the G-E plastics department with headquarters in that city. Mr. Haylon, who replaces N. S. Stoddard, resigned, is a native of Pittsfield and a graduate of Providence College, and was formerly on the staff of the *Cincinnati Post*.

PLASTICS INLAYS, INC., SUMMIT, N. J., REPORTS THAT it has named H. P. Van Tassell as representative in the metropolitan New York area.

RÖHM & HAAS CO., INC., PHILADELPHIA, PA., MANUfacturer of Plexiglas and Crystalite, announces the appointment of Gerald P. Young as West Coast representative with headquarters at 342 Tenth St., Santa Monica, Cal.; telephone, Santa Monica 50712.

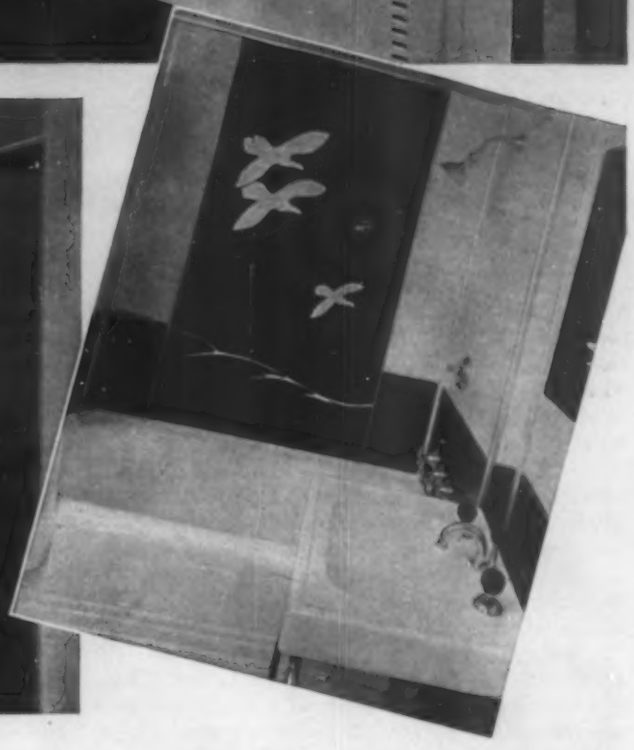
THE NEVILLE CO., PITTSBURGH, PA., STATES THAT it is now producing Cyrene Resins, modified polystyrene resins of the hydrocarbon, thermoplastic type. The resins are described by the company as non-saponifiable, resistant to water, acids and alkalis and soluble in aromatic hydrocarbons, but with high solvent retention. Said to be hard, tough, elastic and not compatible with vegetable drying oils, they are suggested for use in such fields as adhesives, plastic molding compounds, surface coatings where contact with petroleum oils is necessary, and where elasticity and freedom from tackiness are desired.

PRO-PHY-LAC-TIC BRUSH CO., FLORENCE, MASS., reports the retirement of its chief engineer, William S. Elliot. Charles E. Dawson, formerly with the Holyoke Vocation School has filled this position.

FREDERIC SELJE GIVES NOTICE OF HIS RESIGNATION as director of interior art and body design of Chrysler Corp., He has opened offices at 9533 Brighton Way, Beverly Hills, Cal., for the practice of interior design, package design, and product and transportation styling.

BIRDSBORO STEEL FOUNDRY AND MACHINE CO., Birdsboro, Pa., announce that R. C. Cannon, vice-president in charge of casting sales since 1929, is now in charge of the entire sales activities of the company. *(Please turn to next page)*

Plain or Fancy Formica Walls are Always DURABLE and PRACTICAL



FORMICA walls for the bathroom and kitchen, whether they are plain and simple, or highly decorated with inlays in metal or color, are serviceable and easy to care for. They wash easily with soap and water; they are not spotted by ordinary liquids; they do not crack if the walls shift; they maintain their original color indefinitely. Therefore, after years of use they look exactly as they did the day they were installed and that may be very good indeed. Such walls have been used in bathrooms of many of the world's finest ships, and for various purposes in fine trains and hotels. A reduction in price now makes them available for the modest residence or apartment. Complete details on request.

The Formica Insulation Co., 4620 Spring Grove Ave., Cincinnati, Ohio

FORMICA

FOR BUILDING PURPOSES

DELTA MFG. CO., MILWAUKEE, WIS., ANNOUNCES that James Tate, director of sales has been elected a vice-president. Robert P. Melius has been appointed general sales manager and Robert C. Beck, assistant sales manager. Also, Frederick W. Vorck and Jack Mather have been made sales managers of the Eastern and Western divisions, respectively.

THE FRANKLIN INSTITUTE, PHILADELPHIA, OPENED an exhibition, January 9, of biological, botanical and mineral specimens, imbedded in clear Plexiglas blocks by a special technique developed by Dr. Charles E. Sando, of the United States Department of Agriculture. Award winners in the Scientific group, 1938 Third Annual Modern Plastics Competition, these specimens are preserved for all time in their true form and color and may be viewed from any angle.

Also on display at the Institute, is the Bakelite Travelcade, an exhibit of various plastics made by this company, which includes a Reed-Prentice injection press, molding souvenir plaques. In connection with this display, the company sponsored a technical meeting on January 30 with James F. Fredrickson of John W. Masury and Son, as chairman. The subject of the meeting was *New Development in Protective Coatings for Industry* and interesting papers discussing coating applications, materials, etc., were presented by A. J. Weith, Dr. R. J. Moore (Bakelite Corp.) and A. K. Doolittle (Carbide and Carbon Chemicals Corporation).

W. F. KNEBUSCH, FORMERLY ASSOCIATED WITH Rayon Machinery Corp., reports that he has resigned from that company and is now assistant chief engineer at the Dayton division of Harris-Seybold-Potter Company.

A SCHEDULE OF GIFT SHOWS TO BE HELD IN SEVERAL large cities has been issued by G. F. Little Management, Inc., New York. After leaving the Palmer House in Chicago, Feb. 9, the shows will be in New York at the Hotel Pennsylvania, Feb. 19 to 23; in Boston, Hotel Statler, March 4 to 8; Philadelphia, Hotel Benjamin, Franklin, March 18 to 22.

ARTHUR E. URY, WHO HAS BEEN A MEMBER OF THE advertising staff of Owens-Illinois Glass Co. for several years has been transferred to the company's merchandising division as assistant to Howard A. Trumbull, manager. Walter D. Plummer, of the advertising division will take over Mr. Ury's former duties.

EAGLE ELECTRIC MFG. CO., INC., MANUFACTURER of electrical specialties, reports it is celebrating its twentieth anniversary during 1940. The company now occupies 7 buildings including its own molding plant, Eagle Plastics Corp. at 135 Walton St., Brooklyn, New York.

DESK BLOTTER PADS, CALLED VIS-O-TOP, WITH A transparent flap top of Plastacele cellulose acetate plastic, a du Pont material, are now being made. Price lists, charts, etc., can be placed for quick reference beneath the transparent plastic, which covers the entire pad surface. The plastic sheet is hinged on to permit easy use of the blotter which fits into the pad base. The pad base and the binding for the plastic sheet edges are a leather-like material, either green or brown.

D. O. SAWYER FORMERLY OF THE CHICAGO MOLDED Products Corp. is now connected with International Molded Plastics, Inc., of Cleveland, Ohio.

WE ARE INDEED SORRY TO LEARN OF THE DEATH of George E. Gustafson, general works manager of Kearney & Trecker Corp., Milwaukee, Wis., who was killed in an automobile accident on January 8. Mr. Gustafson was associated with the company for a period of 13 years serving as sales engineer, advertising manager and for three years, works manager.

A COURSE IN PLASTICS IS BEING OFFERED DURING the first twelve weeks of the Winter Term of the Evening School by the Department of Chemical Technology of Pratt Institute, Brooklyn, N. Y., which is under the direction of Dr. Tod G. Dixon. The course is being conducted two evenings a week, on Monday and Tuesday, beginning at 8 P.M. The instructor is Paul Moeller of the Celluloid Corp. Prerequisite for the course is a knowledge of Organic Chemistry. Contents of the course will include: Chemistry of plastic materials—ebonite, phenol-formaldehyde resins, urea-formaldehyde compounds, celluloid and cellulose compounds, casein plastics, and other molding compounds; Technology of plastics—hydraulic plant and equipment, mold design and construction, inspection and testing; Development of the field of plastic materials with respect to utilization and new types; Future of the plastic industry.

AN EXHIBIT OF DECORATIVE APPLICATIONS OF plastics, including furniture, sculpture, ornaments, etc., is being held at the show rooms of Emma Romeyne, Inc., 32 E. 57 St., New York, and will extend to February 15, it is reported.

ARTHUR R. TINNERHOLM HAS BEEN APPOINTED product engineer of the Ft. Wayne plant of the General Electric Co's. plastics department and will take up his duties there immediately. A native of Pittsburgh, Mr. Tinnerholm, for six years was with Mica Insulator Co. in Schenectady, and later became sales manager and factory superintendent of Specialty Insulation Mfg. Co., at Hoosick Falls, N. Y.

R. C. WHITMAN, FOR THE PAST 10 YEARS WITH MONsanto Chemical Co., resigned recently and has joined Agicide Laboratories, Inc., of Milwaukee and Los Angeles, manufacturer of insecticide concentrates, foundry parting and nut shell flour for industrial uses. Mr. Whitman will be a member of the technical staff and will represent the company as Eastern district manager.

THE NEW YORK WORLD'S FAIR 1940 IS SCHEDULED to open on May 11, with many new and spectacular attractions. Most of the industrial displays are expected to remain intact. Many will make their shows bigger and better than last year. Some of the foreign buildings and their intensely interesting exhibits will be among the missing.

An independent survey of last year's audience indicates that visitors were of pretty high caliber—representing the more desirable selling markets and potential buyers. Five-sevenths of the visitors had incomes of more than $2000, according to the survey released by Leo Casey, director of public relations for the World's Fair.

Market Analysts, who made the survey, reports that one in every six visitors was a member of a profession; that all visitors had twice as much high school education and ten times as much college training as the nation at large. This information was obtained from personal conversations with a random cross section of Fair visitors, it is revealed.

It is too early (as this is written) to list plastics manufacturers who will continue to exhibit in 1940—or who may enter the Fair this year for the first time—but among them will be du Pont, Westinghouse and Tennessee-Eastman, according to reports.

A NEW HIGH MELTING SYNTHETIC WAX, MADE from domestic raw materials has recently been introduced by the Glyco Products Co., Inc., 148 Lafayette St., New York, under the name of Acrawax C. This product has a melting point of 133–134 deg C and yet is not hard and brittle like most high melting waxes, it is reported.

It is said to be insoluble in water and soluble hot in mineral spirits, turpentine, toluol, naphtha and similar hydrocarbon solvents. Solutions in turpentine, naphtha and toluol produce a stable gel on cooling. Acrawax C blends with paraffin, carnauba wax, candlilela wax, rosin, etc.

Publications

Write for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices.

Design by Light

by Merle E. Rober and Robert M. Wright
Published by J. H. Jansen, 315 Caxton Bldg., Cleveland
Price $4.50 (15 color plates and text in convenient portfolio)

This portfolio of designs represents a method of translating any given object into black and white drawings or designs in color. Through this method, any article can be decorated by means of its own shape and form. The resulting pattern may be a realistic interpretation or an abstraction from which the object creating it is far removed.

Such simple forms as shoes, hats, watch boxes, lock washers, gears and lamp bulbs produce surprising patterns of decorative design when submitted to this theory of design by light. It is a self-starter for original creative work, baffling perhaps to the lay mind, but interesting and definitely useful to students of commercial and industrial design. E. F. L.

American Art Today

Edited and published by National Art Society, New York
Price $3.50 **342 pages**

This is the official catalog of contemporary American art exhibited at the New York World's Fair, 1939. As such it becomes an important record of the best work of individuals chosen from representative groups throughout the United States. It illustrates the work of many new artists who, in the judgment of more experienced artists on the juries, show promise of carrying on the tradition of American art. Paintings, sculptures, drawings and prints, representing the best efforts of more than 1100 artists are shown in this remarkable and historic volume.

Holger Cahill, director of the Exhibition, has written the interesting analysis which outlines the position the artist holds in our modern society. He points out many of the problems as well as the opportunities which exist for those who attain their greatest satisfaction, and possibly their means of livelihood, from the experience of creative expression.

The Script Letter

by Tommy Thompson
The Studio Publications, Inc., New York and London
Price $3.50 **127 pages**

To say that script lettering has returned is somewhat of an exaggeration because it has been with us always, or nearly always. And with us it will always be, for it is a clear and intimate medium of expression of individual thought which commands and gets attention. Script has warmth and grace seldom approached in more mechanical forms of type. The proper forming of script letters is important indeed and for that reason, students, art directors, designers and advertisers will welcome the completeness with which the author has written and illustrated this work. Tommy (Samuel Winfield) Thompson is a contemporary master of lettering and layout in England who generously shares his mastery and knowledge of these arts in this practical "How to do it" volume. E. F. L.

PORTER-CABLE MACHINE CO., SYRACUSE, N. Y., HAVE recently issued *Modern Maintenance Methods*, a manual picturing, describing certain mechanical devices which are claimed to speed and lighten the work of maintenance.

ENGINEERING DATA ON REX-BELLOWS STAINLESS steel flexible tubing is contained in a new bulletin issued by Chicago Metal Hose Corp., Maywood, Ill. Both divided and fully corrugated forms are shown, together with couplings and the new pressure and vacuum tight joint, secured by a special process which is said to eliminate soldering and brazing.

CATALOG NUMBER 40, PRESENTING COMPLETE INformation on Atlas machine tools and equipment for 1940, has been released by the Atlas Press Co., Kalamazoo, Mich. Several new attachments and accessories are announced along with the year's design improvements in lathes, drill presses, arbor presses and shapers.

A 12-PAGE ILLUSTRATED CATALOG GIVING FULL information on design, construction, special features, capacities and specifications of Abbé pebble and ball mills for pulverizing, grinding, mixing, etc., has recently been issued by Abbé Engineering Co., 50 Church St., New York.

SCREW MACHINE ENGINEERING, ORIGINALLY issued in a multigraphed form, is now being published as an illustrated monthly magazine at 34 West Main St., Rochester, N. Y. According to H. P. Berry, editor, the magazine will feature subjects of interest to those directly associated with screw machine work and will contain news of the industry.

SOUTH BEND LATHE WORKS, SOUTH BEND, IND., has recently published a new 48-page catalog, illustrating and describing their complete line of 9-in. workshop back-geared, screw cutting lathes and attachments. The lathes shown in this catalog are recommended by the company for use in repair shops, manufacturing plants, garages, laboratories, home workshops, and experimental shops where back-geared, screw cutting type of lathe is required.

CIRCULAR ISSUED BY VACUUM SYSTEMS, INC., Cleveland, Ohio, relates to its development method of extracting air and gas from plastic molds by its Crescent Vacuum Pump. Bulletin No. 10 giving complete description and specifications of the pump is available.

DEWAR MFG. CO., 34 THIRTY-FIFTH ST., BROOKLYN, N. Y., has issued a bulletin on the electrically driven Meeker Power Hammer, claimed to be useful for forging dies, sculptural carving, drilling finishing hobs and dies and for delicate work on steel, brittle stone or wood.

A NEW ILLUSTRATED BULLETIN FEATURING APplication, construction and uses of synchronous motor-driven running time meters for use in connection with radio transmitters, X-Ray tubes, welding machines, testing laboratory equipment, pumps, refrigerators, punch presses, etc., has been published by R. W. Cramer Co., Inc., Centerbrook, Conn.

A PRACTICAL DISCUSSION ON THE SUBJECT OF HEAT transfer as applied to constant temperature laboratory equipment is contained in a recent bulletin issued by Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.

INTERIOR DESIGNERS AND DECORATORS WILL welcome the du Pont Color Selector recently made available to help them settle color problems with clients quickly and with lasting satisfaction. It is a loose-leaf book containing 101 twelve by eighteen-inch sheets, each painted in a different color. The color range, including a dozen Early American Colonial colors, is considered complete enough for every practical need. There are also transparent plastic overlays printed to show how a living room, dining room, bedroom or kitchen will look when painted in any one of the 101 colors. A small booklet, also furnished with the Color Selector, tells how to make all the colors.

CLASSIFIED

WANTED: Stainless Steel or Nickel Kettle, Vacuum Pan, Hydraulic Press, Preform Machine and Mixer. Reply Box 275, Modern Plastics.

PLASTIC MIXING & MOLDING EQUIPMENT—Factory rebuilt—Hot Rolls or Mixing Mills, Hobbing and Die Sinking Presses, Semi-automatic and Standard Molding Presses, Hydraulic Pumps, Accumulators, Intensifiers. Reply Box 294, Modern Plastics.

FOR SALE: Watson-Stillman Hydro-Pneumatic Accumulator, 8" ram, 48" stroke, 42" air cylinder, 5000 lb. PSI, complete with high pressure air receiver and interconnecting fittings; 3—Watson-Stillman 4-cylinder opposed Hydraulic Pumps, 6000 lb. PSI, 25 GPM, motor driven. 100 HP AC motors; 6—24" x 24" Hydraulic Presses, 12", 14" rams; 2—30" x 30" Hydraulic Presses, 14" rams; 60" Mixing Rolls. 2—300 gal. Nickel Agitated Jacketed Vacuum Stills; 1—200 gal. Nickel Agitated Jacketed Vacuum Still. Reply Box 326, Modern Plastics.

WANTED: CELLULOSE ACETATE SCRAP, unground or reground, as well as lumps, also acrylic or methacrylic resin scrap and celluloid scrap. Send details concerning quantities and price. Reply Box 318, Modern Plastics.

Representative Wanted: A progressive injection molder in the middle west is seeking representation in the northwest centering in St. Paul area, preferably a man now calling on the industrial trade. Will also consider representative residing in St. Louis for southwest territory. Reply Box 333, Modern Plastics.

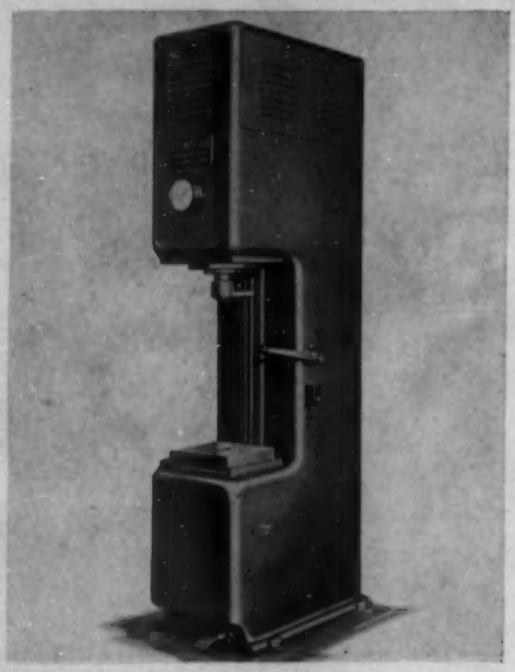
WANTED: Scrap Methyl Methacrylate, Scrap Lucite, Plexiglas and Crystalite. Advise quantities available and price. Reply Box 334, Modern Plastics.

FOR SALE: Plastic & Molding equipment. Rebuilt and Guaranteed. Large stocks Hydraulic Presses, Pumps & Accumulators. Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizers, Tumbling Barrels, Drill Presses, Lathes, Gas Boilers, etc. Send for Bulletin #146 and #128. We also buy your surplus machinery for cash. Reply Box 335, Modern Plastics.

VACANCY—Opportunity for a man with extensive research experience in plastic materials to plan and conduct research for development of new and improved plastic materials. Location, Southern Central New York State. Send recent photograph and full details regarding training, experience, religion, age, marital status and salary expected. Correspondence will be kept confidential. Reply Box 336, Modern Plastics.

Attention of a manufacturer of plastic material who has need of a man thoroughly qualified to handle sales; sales promotion; merchandising or advertising. Excellent correspondent. Average earnings $8,500 a year by intelligent hard work of from 8 to 12 hours a day. At present employed in plastic research by automobile manufacturer. Willing to step down and prove ability in order to step up later. Highest references. Reply Box 337, Modern Plastics.

Equipment



DESIGNED FOR INCREASED EFFICIENCY OF PRODUCTION on modern straightening, assembling, broaching and similar operations, the vertical hydraulic press, illustrated above, is manufactured by Denison Engineering Co. It is available in four sizes with working capacity of 5 to 50 tons, and has adjustable stroke of 26 in. maximum. Vertical opening with stroke up, measures up to 29 inches. According to the company's descriptive brochure, power is supplied by a motor driven pump and control is by foot pedal and a hand lever, operation of either causing the ram to move downward. When both are released the ram rises to the limit of its predetermined *up* stroke. Pressure is then released automatically to conserve power between strokes.

A NEW MACHINE OF THE BONDED-ABRASIVE WHEEL type is being made by the American Instrument Co., for cutting glass, plastics, quartz, ceramics, metals, etc., in the form of sheets, rods, tubes, and blocks. Cuts up to $3\frac{1}{2}$ in. can be made on materials with flat surfaces. Rods, tubing, and the like up to 6 in. thick can be cut by rotating the material as it is being cut.

True, clean cuts are said to be made speedily and precisely by means of a motor-driven 12-in. diameter rubber-bonded abrasive wheel (0.04 or 0.06 in. thick)—without chipping or breaking the material. Very short lengths are easily cut, it is claimed.

GEORGE SCHERR CO., INC., ANNOUNCES IT IS MARketing an improved Swiss automatic screw machine, manufactured by Tornos, one of the largest screw machine manufacturers in Switzerland. The line consists of seven models with spindle bores to take bars up to $\frac{9}{32}$ in. and to $1\frac{9}{16}$ in. in diameter. They are claimed to be particularly suitable for producing long, thin work, fine shafts and the most delicate pivots requiring great accuracy and fine finish. All are available with turning tools.

A USEFUL, POCKET-SIZE REFILLABLE TESTER FOR holding and dispensing Alkacid paper in ribbon form is announced by Fisher Scientific Co. With this device and special indicator paper, a more accurate measurement of the approximate pH (how acid or how alkaline?) of liquids is reported possible. The tester, $2\frac{1}{2}$ in. in diameter and $\frac{1}{2}$ in. thick, consists of two transparent plastic covers separated by a rubber gasket so there is an enclosed space for a color chart and 15 ft. of ribbon which is sealed against contamination by laboratory atmosphere.

NUMEROUS TYPES OF CONVEYOR AND PROCESSING belts can be obtained, Audubon Wire Cloth Corp. reports, in any ductile metal resistant to various operating conditions, i.e., flame, high temperatures up to 2100 deg F., sub-zero temperatures, corrosion, contamination, abrasion, impact, etc. These belts are said to have the longitudinal flexibility of leather, canvas or rubber, so that they can successfully run over small diameter pulleys and take acute reverse bends.

SPEED, ECONOMY WITH PLYWOOD

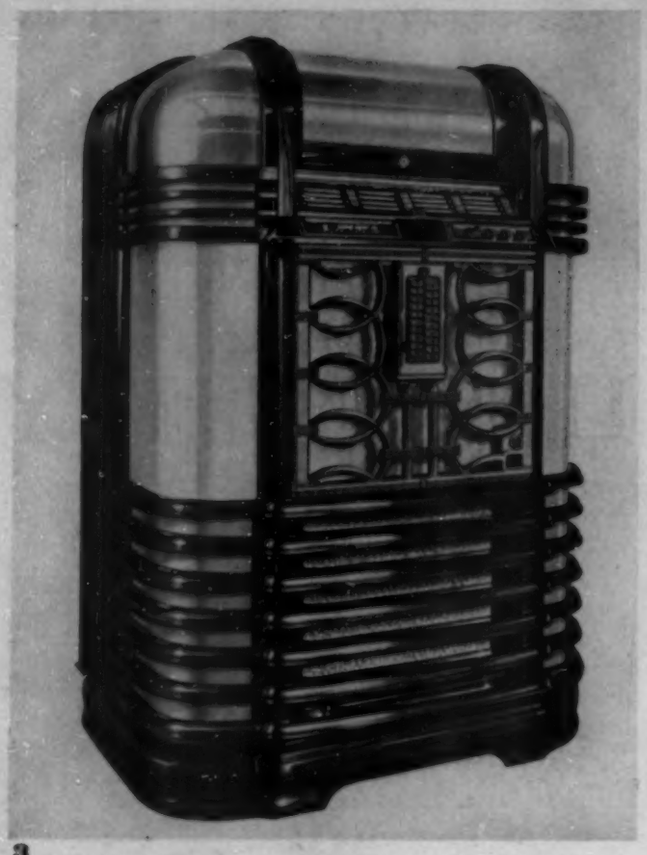
(*Continued from page 25*) learned that in this type of plywood he gets all these attributes and more. He gets a material which enables him to build faster—one that has excellent insulation properties—one that will take curved shapes or can be curved to specific shape at the factory, permitting modern design at small extra cost. In fact, these gas stations almost can be prefabricated.

By using screws for attaching the plywood panels, both inside and out, more than fifty percent of the entire building material can be salvaged if traffic changes should demand its removal to another location.

Sparkling white painted Resnprest exterior panels give all weather protection to this modern gas station

The use of phenolic resin-bonded plywood for service stations does not end when exterior wall construction is completed. It is used for roofs and subfloors and even the cut-out sign letters. It has excellent rigidity and $\frac{5}{16}$ in. sheathing has been shown by the U. S. Forest Products Laboratory to be 5.9 times superior to horizontal lumber and forty percent better than diagonal sheathing or bracing. Phenolic resin-bonded plywood can be laid faster than conventional subflooring. It is far less likely to warp or shrink—which means less opportunity for annoying squeaks. Because the bond will not delaminate, cut-out signs and letters will be as enduring as the station itself.

Resin-bonded plywood is very definitely reducing costs for service station construction. Where wood construction is permitted for such buildings, large and small oil companies are instructing their operators to investigate possible plywood construction first.



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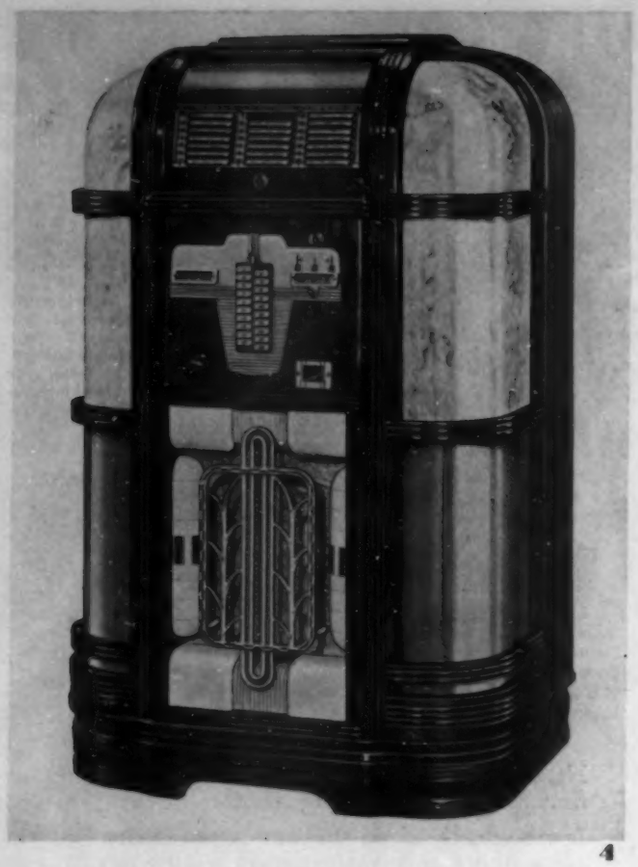


4

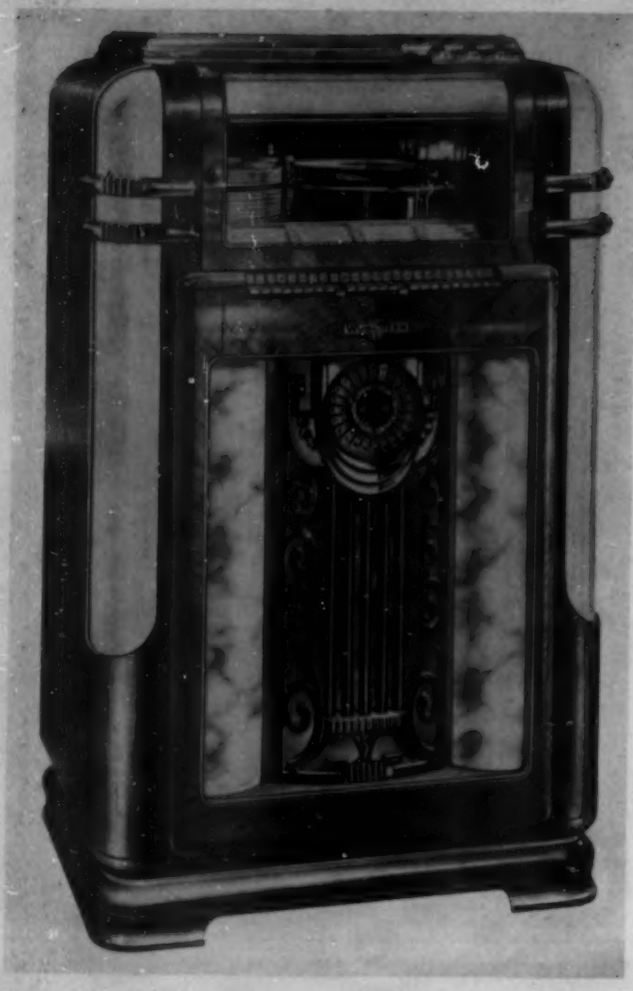
Capitalizing on the animation and color of translucent illuminated plastics, Rock-Ola standard **4** and de luxe **3** automatic coin phonographs, light up as they play. Almost the entire front of the cabinets, including top caps, pillar sections and multi-colored sheets behind the speaker grille are cast phenolic

VENDING MACHINE GLAMOUR

(*Continued from page 27*) In often crowded quarters, it must draw a crowd—and yet it cannot shout or plead with human tongue. Under extreme conditions of temperature, lighting, and wear, the coin machine must continue to perform—mechanically as well as visually. It is this positive need to influence the eye of the customer and to make the eye create the desire for a smoke—for something to eat—a tune to listen to—or a cool drink—that is responsible for the design consciousness of the industry. It seems but a step from any intelligent analysis of vending machines to the conclusion that plastics are their natural ally. In plastics, the vending machine industry finds an answer to its call for brilliant color—for a material pleasant to the touch, precise in shape but with maximum flexibility. The gradual but continuous *opening up* of coin-operated phonographs, with phenolics more and more supplanting wood and metal, are a good example. Conspicuous in this instance is the advance made by the plastics producers in the size and variety of shapes of individual castings and moldings. Of the plastic materials most widely used, I believe, the cast phenolics, cellulose acetates, and casein plastics play perhaps the most significant part. However, this listing does not claim to be complete, in particular with reference to interior construction, and the future will most certainly bring forth applications of a greater variety of plastics.

One of the most appealing qualities to the vending machine manufacturer is the excellent adaptability of large plastic housings to both day and night use. Very interesting and effective types of illumination have been worked out which easily double the attention value of a machine and which would have been impossible in any other traditional opaque material. Color variety, without increase in cost, and color fastness and permanency are further assets of the plastics to mechanisms which require strength and resistance against physical abuse as well as high visual attraction. It has been interesting to me to observe how, with the growing use of plastics, the cabinet design has changed over to an entirely new freedom in the development of shapes. Large flowing curves alternate with sharp flutings—the purely *façade* type of design is giving way to a really plastic conception of the machine as an object to be seen from all angles at last. This growth of sureness in design goes hand in hand with greater familiarity in the use of plastics.

Even beyond the volume of sheet and molded plastic material which goes into the decorative and illuminat-

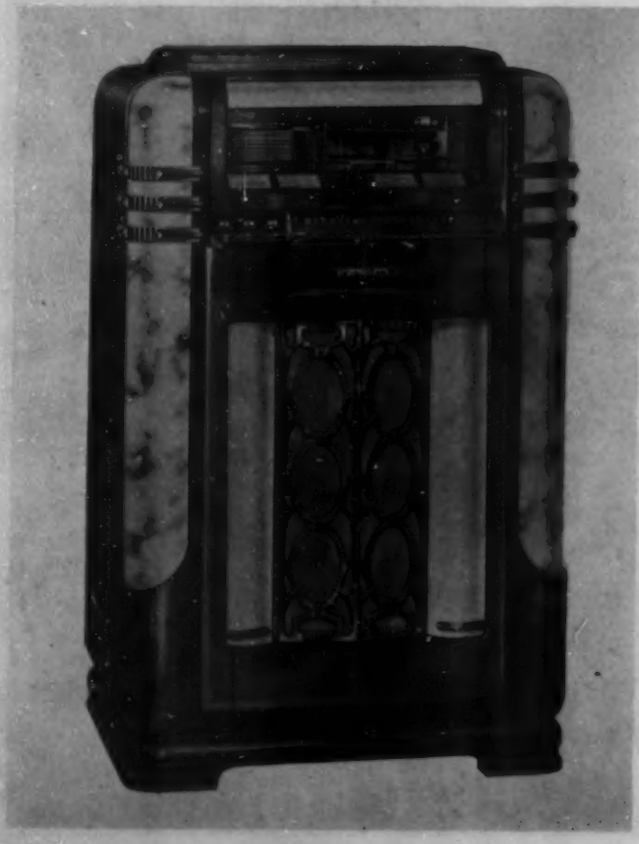


ing elements of the coin-operated vendors of music, 15 million pounds of plastic material go yearly into phonograph records for exclusive use in coin machines.

This is based on an estimate made last September by *Fortune* magazine which calculated that coin machine phonographs would use 30 million pounds in 1939 and 50 million in 1940. Each record weighs one-half pound. Besides using records themselves, the coin-operated phonograph industry has stimulated the use of phonograph records in the home on modern combination radio phonograph machines.

In the degree to which the resin manufacturer is adapting himself to the needs of the vending machine industry, so this industry is learning how to employ the plastics to best advantage. New surfaces, new colors, new methods of assembly and interior illumination are being developed with amazing speed. It is regrettable that a good deal of carelessness still prevails in the number and types of materials sometimes combined in one cabinet. Instead of increasing their effectiveness they at times only serve to defeat their individual qualities by too many conflicting surfaces and colors. However, at the rate at which the industry moves these youthful diseases will probably soon be remedied.

To the plastics industry the future of the vending machine remains of great importance. To the vending machine industry the plastics have given the color and brightness which is helping it to transform its products from the awkward appearance of yesterday into the *glamour boys* of today and of tomorrow.



Bright plastic parts stimulate earning power and eye-appeal of the Wurlitzer line of music machines **5-7**. Round record indicator disk of polystyrene, transparent cellulose acetate sheets back of record selectors and grille, and cast resin rods are gay notes. Counter model below has selector buttons injection molded of acetate. Translucent nameplates and variegated cast phenolic pilasters enliven all models

4

5

4 Molded Ethocel wall units in Dow Chemical Co. offices diffuse light and prevent sunglare. **5** A miniature glimpse into the future—this functionally designed home is constructed entirely of tiny plastic building blocks

CONSTRUCTION UNITS APPEAR

(*Continued from page 31*) Through their use in walls and ceilings, rooms can be given a lightness, an airiness and an atmosphere of cheerful comfort not now possible. For solariums in homes, a combination of transparent and translucent blocks would allow the admission of the maximum amount of light, without glare, which could be controlled and distributed to suit the individual taste of the builder.

Plastics that absorb sunlight during the day and give it off in a soft glow in the darkness will add interesting possibilities such as silhouetting planting around a luminous building, or a door knob that will glow in the darkness.

The fact that plastics can be furnished in a variety of colors will be pleasing to housewives who have an eye for decorative possibilities. Interior walls can be made in any shade or combination of shades to fit any color scheme. The smooth polished surface is easy to keep clean and is not easily scratched or marred. Husbands who think in terms of the family budget will be impressed with the fact that the beautiful finish is a permanent part of the block. Exteriors will need no surface coatings such as paint, costly both for initial application and subsequent upkeep. Nor will it be necessary to plaster, paint or paper interior walls.

This elimination of the need for using other materials will result in a unification of labor required in building which in turn should materially reduce costs and the amount of time required for construction. The lightness of plastic blocks and the ease with which they are handled and mounted in place will also lighten

the burden of workmen. This lightness will be a big factor in lowering shipping costs as well as in relieving the strain of heavy walls on foundations. Experiments with this type of construction using molded blocks have been conducted in three buildings recently designed by Alden Dow. The side walls of The Dow Chemical Co. exhibit at the San Francisco Golden Gate International Exposition were made of green, translucent ethylcellulose. Opaque plates of styrene were used overhead.

Translucent blocks of light amber ethylcellulose were used advantageously in the wall construction of the recently completed addition to the main offices of The Dow Chemical Co. These transmit a softly diffused light and at the same time provide protection from sunglare. Translucent styrene blocks were also used effectively in the bath house of Midland's new swimming pool to admit light overhead while retaining privacy for those occupying dressing rooms.

According to Dow, these plastic materials, which offer a wide range of colors and textures, also present extensive possibilities for use in the manufacture of furniture and fabrics.

IMPROVEMENTS IN INJECTION MOLDING PRESS EQUIPMENT

(*Continued from page 49*) the material immediately falls to the hot section of the cylinder and has the advantage of being preheated.

Fig. 1 shows a piece taken from a vertical heating cylinder with hollow type plunger and clearly indicates that the material is quite well plastified before reaching the spreader. It will also be noted that the spreader is much shorter than the conventional torpedo, offering much less resistance to flow of material and thus requiring less pressure. (*See page 49*)

In addition to the heating cylinder, a second demand placed on the press was the necessary speed of injection. Some of the acetates are not true plastics and gain their ability to flow from plasticizers. These materials have a plastifying variable in proportion to the heat supplied—more heat, more plastic—until the burning point is reached. Such materials can be injected into a mold with a reasonably slow speed because they do not chill to the set-up point so rapidly. The newer materials such as the methacrylate, vinyl and styrene resins are more truly plastics, requiring no plasticizer, and heat beyond a certain point does *not* make them more plastic. In such cases, set-up in the mold is very rapid and material must be injected at great speed to offset this.

Speed of injection has been gained with greater capacity pumps and with greater pressures to maintain speed when resistance is met. This speed and this pressure must be governable, independently from the mold closing system. A control system which regulates piston travel *without* loss of pressure during any portion of the injection period has been developed. This makes for a lower temperature requisite. With such control, the hazard of frictional nozzle heat which usually tends to burn material can be eliminated.

The third problem introduced by the new materials is the tendency of molds to open, because some of the materials reach a very fluid state and the pressures exerted are nearly pure hydraulic. Mold-locking pressure and alignment have been gained by the beam construction instead of tie-rods and by link lock closing where the major pressures are on heavy links instead of pins. In some cases hydraulic locking has been used, but it is not universally adopted because of speed and capacity.

The last and by far the greatest problem which new materials introduced was that of injection piston sticking. There must be a definite clearance between surfaces of the cylinder and piston walls, and the fine, hard powder of some materials creeps back into this clearance, regardless of how much bearing there is on the plunger on the return stroke. In most cases, this powder backs to one side of the plunger, forcing it to one side. This results in terrific pressure on a small area with great friction and causes scoring regardless of the material used in the construction of the piston and cylinder.

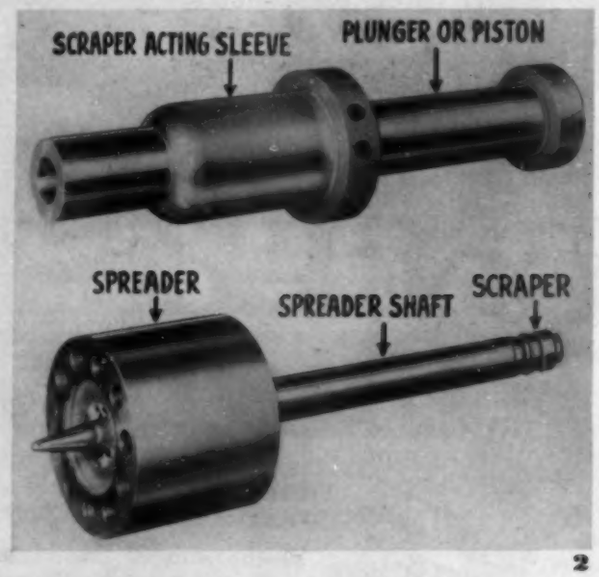


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Fig. 2. illustrates the scraper shaft and design of a new type vertical injection cylinder assembly (patents pending) to offset piston sticking trouble. Developed by Lester Engineering Company

To offset this, an assembly (Fig. 2) was developed in which the plunger withdraws from the cylinder entirely into a guide. If there is any material adhering to the outside of the plunger, it will be stripped away on the return stroke. Later, the spreader shaft on the hollow plunger was so designed that the shaft acts as a scraper, cleaning the inside of the plunger on each stroke. This new design (patents pending) of outside scraping and inside scraping has eliminated all sticking trouble regardless of material used or quantity molded.

TABLE 4. RÉSUMÉ OF CHANGES IN DENTURES IN SERVICE

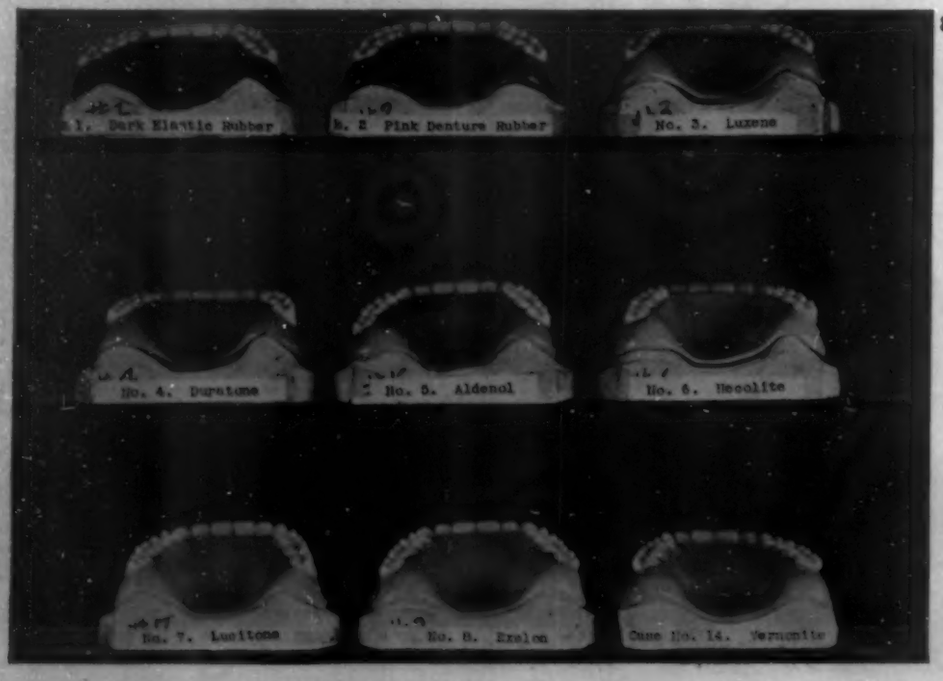
Case No.	Type of Denture	Base Material	Time in Service	Change Across Posterior	Fit on Model	Color Change
				Percent		
1	Full Lower	Aldenol	1 Month	−0.35	Satisfactory	None
2A	Full Upper	Duratone	1 Year	Excessive shrinkage	Not satisfactory	Very unsatisfactory
2B	Full Lower	Duratone	1 Year	−0.44	Satisfactory (tight)	Slight fading
3	Full Upper	Aldenol	3 Months	+0.15	Not satisfactory	Brownish
			1 Year	+0.54	" "	"
5A	Full Upper	Vernonite	1 Month	+0.24	Satisfactory	None
			9 Months	+0.59	"	"
			17 Months	+0.51	"	"
9	Full Upper	Vernonite	7 Months	+0.06	Satisfactory	Slight darkening around two teeth
11A	Full Upper	Rubber	6 Months	−0.11	Satisfactory	Stained
			15 Months	+0.08	"	"
11B	Full Lower	Rubber	7 Months	−0.04	Satisfactory	Stained
			15 Months	−0.11	"	"
12	Full Upper	Luxene	1 Month	−0.52	Satisfactory	None
			5 Months	−1.04	Satisfactory (tight)	None (some stain)
			13 Months	−1.55	Not satisfactory	Faded and stained

DENTURE BASES: ACRYLIC RESINS

(Continued from page 47) A full upper denture (Table 4, Case 2) after one year's service would not go to place on its model by 1.5 mm at the posterior palatal periphery. The patients, in all of these cases, said the dentures gave them satisfactory service and caused no discomfort in the mouth.

The number of cases is too few to draw any general conclusions, except that they indicate that the dentures, made of phenol-formaldehyde resins, were not color-stable in service and that the acrylic acid resins were far superior in this respect.

Warpage of dentures. In order to study the change in fit of dentures when they are placed in service, nine similar full dentures were made from one master model. A stone model of the bearing surface was made of each denture after it was polished and finished. A sample of the stone model and a denture are shown in Fig. 7. Of the nine dentures, two were rubber, three were phenol-formaldehyde resins, one was a cellulose compound, and three were acrylic resins. All of the dentures were made of materials purchased in the open market, and were processed by a commercial dental laboratory, according to the directions accompanying the respective materials. These dentures were then



Dentures replaced on stone models after storing in water 15 days. Accuracy of fit may be judged by noting the space between the denture and the model

stored in water at approximately 37 deg. C. for 15 days and were replaced on their respective stone models. The results are shown in Fig. 8. It is evident from a study of this photograph that some of the dentures so treated warped appreciably. In fact, some did not go to place on the model by as much as 1 to 2 mm in the palatal area. The dentures made from rubber and acrylic resins showed less warpage than the phenol-formaldehyde resin dentures. Inasmuch as the first eight of these dentures were made up and treated identically and the ninth (No. 14) comparably, it seems quite significant that such a large variation in dimensional stability was observed.

When all factors are considered, the acrylic resins appear to be the most satisfactory plastics currently used for denture bases.

HOW DO COSTS COMPARE?

(*Continued from page 29*) whatsoever left for the compression machine except, of course, the difference of raw material characteristics. The majority of thermoplastics, however, still costs about 50 percent more than the ureas and almost four times as much as the phenolics. Hence, the advantages have to be contrasted with the disadvantages very carefully in order to see which outweigh the other. Inasmuch as the quantities, weight, and method of molding each new item vary in accordance with utility and design, it is impossible to make any general rule, but it is easy to recognize that a certain relationship exists between a heavy and a light piece when comparing the costs of injection with those of compression molding. In other words, the cost of a very heavy finished article in a thermoplastic material is bound to exceed the saving that can be realized in molding it. Conversely, the increased material cost of a thermoplastic compound will be offset in a small molded part by the savings which can be enjoyed in faster molding cycles.

Table 1 (page 28) shows the comparative cost of two methods of molding based on varying mold capacities and weights, and the graph (Fig. 2) represents the manufacturing costs for the conditions as recorded. It will be noted that the first and second columns give the number of cavities and the weights in pounds per thousand pieces. Material costs are based on urea compounds at 31¢ a pound plus 16 percent for flash as compared with acetate at 48¢ a pound with 5 percent for waste. Press labor for compression molding is figured on a two minute cycle time, while molding labor for injection is placed at three heats to the minute. Both methods have been based on a 60¢ per hour press labor cost, and overhead in both instances is assumed to be 150 percent on labor. A study of this table will disclose the fact that as the item increases in weight the advantage of compression molding becomes greater regardless of the number of cavities utilized. Of course it should be remembered that the comparison is made between a urea material and an acetate and that

the difference would be much wider were a phenolic compared with a thermoplastic type of material.

The graph may be used to compare any of the intermediate possibilities of weights and mold capacities within the range considered. For example, if it is desired to know how an item weighing 30 lbs. per thousand pieces compares in price on a 16 cavity basis between compression and injection molding, it becomes a simple matter to merely read the results on the abscissa. Similarly, if the prime factory cost has been determined on a certain number of cavities for injection molding it is easy to ascertain the required number of cavities for compression molding which would give the same results. Obviously one may tell at a glance just which method is most economical without the need of preparing estimates on various sizes of molds.

After due consideration of the figures in the table it will be conceded that in the molding of very small parts the injection machine enjoys a distinct advantage over the orthodox type of press. It must be remembered, though, that in the majority of applications a great many parts are required in brown as well as black material. Hence if the molder has to produce solely from an injection press he may find himself at a decided disadvantage in attempting to compete with phenolic material at about one quarter the price. Furthermore, removal of gates often proves to be more costly than a less expensive tumbling operation.

So it can be seen that, although the introduction of injection machines has been a real increment to the industry, there still remains a very definite place for both the large and small compression press. Furthermore, unless there occurs another vast reduction in prices of the thermoplastic compounds, this need will not be lessened in the immediate future.

ELASTICITY OF PHENOLICS

(*Continued from page 48*) There are several factors influencing the elastic properties. In Table 1 (page 80) are given some data for different fillers compounded with a single resin in the proportion of 53 percent of resin by volume. The amount of flexibility was measured according to the A.S.T.M. Standard D 48-33. A standard bar $^1/_2$ in. by $^1/_2$ in. by 5 in. is molded and broken between supports 4 in. apart, the load being applied midway between the supports. The distance which the bar flexes or bends before breaking is measured in inches and is called *deflection*. From these measurements an average modulus of elasticity in bending was calculated according to the formula:

$$M = \frac{WL^3}{4\,B(d^3)\,(\Delta)}$$

M – modulus of elasticity in bending in lbs. per sq. in.
W – load on bar at midpoint in lbs.
L – distance in inches between points of support.
B – width of bar in inches.
Δ – deflection in inches of bar at midpoint at break.
d – depth of bar in inches. (*Please turn to next page*)

Table 1. Flexural Properties of a Phenolic Resin Compounded with Various Fillers

Filler	Ultimate Flexural Strength lb./sq. in.	Deflection in.	Average Modulus $\times 10^5$ lb./sq. in.
None	13,500	0.071	10.0
Wood Flour	11,000	.050	11.7
Cotton Flock	11,000	.040	14.7
Asbestos	9,000	.027	17.7
Diatomaceous Earth	9,700	.023	22.5
Mica	10,400	.013	42.7

It will be observed in Table 1 that the filler has a marked influence on the elasticity of the compound and the comparatively inflexible mineral fillers have the expected effect. The higher modulus of elasticity for the mineral-filled compounds means that the material will not stretch quite as far as the wood-flour-filled compounds for a given stress. Another way of interpreting this would be to say that the mineral-filled compounds when deformed the same amount as the wood-flour-filled compounds reach their ultimate strength sooner and consequently fail. The presence of moisture in phenolic molding compound is generally harmful. Moisture content, however, has little effect on flexibility of molded phenolics. Fig. 1 (page 48) shows the effect of variation in moisture content (before molding) of three standard grades of phenolic compound upon the flexural strength and deflection. The extreme variations in moisture content were obtained by conditioning standard compounds in dry air and in air saturated with water vapor for one month at room temperature.

The type of resin used also has considerable influence on the deflection value. By modifications in the resin used, the deflection value for a wood flour compound containing 53 percent by volume of resin may be varied from .040 to .090 in. with no great change in general molding properties.

Field experience has shown that certain grades of molding compound with improved elastic properties have remedied a number of obstinate cases of cracking around inserts. It is suggested that consideration be given to these more elastic types in cases where unusual strains develop in the finished molded piece.

CHLORINATED RUBBER

(*Continued from page 50*) diphenyl and specially treated tung oil, and would contain a soft-type phenolic resin. • Chlorinated rubber chemical resistant finishes have been used successfully in chemical plants, steel plants, pulp and paper mills, the textile industry, and in decorative-type finishes for equipment coming in contact with corrosive materials.

Another field of application for chlorinated rubber finishes is for alkaline surfaces such as concrete, stucco, plaster and cement asbestos boards. For this applica-

tion the alkali resistance of the chlorinated rubber is of great value. Satisfactory finishes for stucco walls and similar surfaces for outdoor exposure have been prepared using mixtures of chlorinated rubber and drying oils. For concrete floor paints, chlorinated rubber can be used either in lacquer-type finishes or as a fortifying agent for phenolic varnish enamels.

Chlorinated rubber has also been used as a fortifying agent for oleo-resinous varnishes for speed of dry and where improved alkali resistance is desired. It is likewise being used successfully in printing inks, especially where alkali resistance is important. Chlorinated rubber is also a good base material for adhesives.

Chlorinated rubber is also an ideal base material for moisture-vaporproof paper lacquers. In this problem it is essential to use plasticizers and resins that have a relatively high tolerance for paraffin wax such as diamyl phthalate. A high melting point paraffin wax is used since moisture-vaporproof determinations are run at 35 deg. C. Chlorinated rubber, as mentioned before, is odorless, tasteless and non-toxic, and, therefore, can be used in connection with labels and wrapping paper for food products.

Of all the uses for chlorinated rubber, probably the fastest growing one is as a fortifying agent for alkyd resins. In 1936 only 1.3 percent of Hercules total sales were used in this application; in 1937, 12.7 percent, and in 1938, more than 20 percent was the figure.

Chlorinated rubber can be used to fortify alkyd resins giving quick dry, improved alkali resistance, and excellent tint retention without detracting from the good weathering properties of the alkyd resin. The following examples will serve to indicate the large number of fields which are open to chlorinated-rubber-fortified alkyd resin enamels:

1. *Trucks and Buses*—Here chlorinated-rubber fortified-alkyds give quick dry on objects too large to be placed in ovens; finishes have excellent outdoor durability. The chemical resistance and toughness of these enamels is an important factor on trucks which come in contact with corrosive conditions.

2. *Washing Machines*—Here chlorinated rubber imparts quick dry as well as resistance to alkaline washing powders and soaps.

3. *Refinishing Automobiles*—Here chlorinated rubber gives quick dry which is especially important during the cold winter months when alkyd enamels dry slowly.

4. *Farm Machinery*—Here chlorinated rubber promotes quick dry, clean dipping and excellent resistance to fertilizers.

Chlorinated rubber has been widely accepted for industrial uses. In protective coatings, especially, it has earned a distinctive position as an important ingredient on many types of finishes. Many paint, varnish, and lacquer manufacturers are using it either separately or as a reinforcing material.

Because of its inherent properties, together with its rapid acceptance by industry, and because of the remarkable improvements made in quality, its future in the protective coatings industry is most promising.